PLANNING FOR M.I.T.

1956-1970

by

Malcolm D. Rivkin

A.B., Harvard
(1953)

Fulbright Scholar
University of Amsterdam
(1953-4)

A Thesis submitted in partial fulfillment
of the requirements
for
the Degree of
Master in City Planning
at
Massachusetts Institute of Technology
May 21, 1956

Signature of Author

Certified by:

Head, Dept. of City
and Regional Planning

May 21, 1956

Professor Frederick J. Adams
Head, Department of City and Regional Planning
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

Dear Professor Adams,

I submit herewith a thesis entitled, Planning for M.I.T., 1956-1970, in partial fulfillment of the requirements for the degree of Master in City Planning.

Sincerely yours,

Malcolm D. Rivkin

ACKNOWLEDGMENTS

My most sincere gratitude goes to Professor Frederick J. Adams and Professor Kevin Lynch, without whose constant encouragement, criticism, and patience this thesis would have been impossible.

Many others gave invaluable assistance by granting interviews and providing data. They are:

Mr. William Alonso
Mr. William E. Balch
Mr. Jerome H. Barraford
Dean Ruth L. Bean
Mr. Lawrence E. Beckley
Dean Pietro Belluschi
Mr. Robert Briber
Prof. Albert Bush-Brown
Mr. Miles P. Cowen
Mr. Robert Emery
Dr. James M. Faulkner
Mr. Henry W. Fitzpatrick
Dean Harold L. Hazen
Mr. Robert E. Hewes
Mr. Robert J. Holden
Prof. Ernest H. Huntress
Miss Mary Hurley
Prof. Reginald Isaacs
Prof. Burnham Kelly
Miss Constance Lurvey
Mr. Joseph C. MacKinnon
Mrs. Alice Manning
Miss Loretta Manning
Mr. Carl M. Peterson
Miss Caroline Shillaber
Dean C. Richard Soderberg
Mr. William B. Thurston

Preparing a final manuscript is a trying task. I am greatly indebted to Mrs. Barbara Westebee, the IBM Company of Cambridge, and most especially, my parents, for their help.

ABSTRACT

Planning for a university requires a comprehensive study of objectives, past physical development, existing facilities, and the surrounding urban environment.

MIT's objectives concern providing suitable, flexible curricula for undergraduates and graduates and fostering non-curricular opportunities for each. Cooperation with government and industry through research is another major objective. For undergraduates, MIT is developing a technical program deeply rooted in basic science, humanities and social studies, and "learning by doing". Closer faculty-student contact and establishment of a residential college are highly important considerations. Graduate training is receiving greater emphasis as the nation requires more highly-trained scientific personnel, and the Institute wants to develop a sense of identification among its advanced students. In both research and graduate training, interdepartmental, integrated programs become increasingly prominent.

When MIT was in Boston, in its embryonic stage, solid technical instruction was almost the sole objective, and a carefully-planned, integrated site proved imppssible to achieve. Since 1916, new objectives have developed and have influenced building activity as well as programs. While the Cambridge site was carefully arranged and afforded much room for expansion until 1939, since then it has been very difficult to realize new aims through development on the existing property...which is collared by a deep industrial zone of expensive land.

A survey of facilities is presented in Chapter III. After relating this data to the discussion of objectives, an enrollment increase of 1500-2000, largely in the Graduate School, is predicted for 1970. Predictions of faculty and personnel increases are also presented, as well as estimates of facilities required by changing objectives and the growth in population.

Three alternative proposals for the location of future building activity are offered. The most desirable seems to be concentration of all new academic and non-classified research activity east of Massachusetts Ave., and of all new student residences (except those for married students with families) west of Massachusetts Ave. It is also suggested that faculty apartments and developments for married students with families be located in residential sections of the city, and that classified research be located outside of Cambridge. Several specific recommendations are made, staged for 1956-1960 and 1960-1970.

TABLE OF CONTENTS

Item Page

- - - - -

INTRODUCTION

Planning the physical development of a university involves a complex series of decisions on a multitude of factors--from educational policy, to enrollment policy, to buildings where the educational policy is carried out and where the students undergo what is undoubtedly the most significant experience of their lives. All of these decisions are interrelated. To make one without the others can be harmful, partly because more students mean more professors, more staff, more building space, more athletic fields, and in this modern world of ours...more room to park the ubiquitous automobile. But the problems are hardly quantitative alone, for a university must also provide an environment and a way of life stable enough to retain integrity through change, flexible enough to adapt to growth and the needs of new generations. Somewhere there may be a breaking-point, perhaps a certain size, perhaps something else, where policy and environment can no longer channel young minds in a way that achieves the objectives the university has set for itself.

M.I.T. is at a critical stage in its development where a comprehensive look at its future seems essential. Twenty years ago Dr. Compton worried about unused facilities and a 1,000-man drop in enrollment, but now the post-depression baby boom is hammering on our doors, and the pressure of far-too-many applications will continue for as long as anyone can predict. Fifteen years of hot and cold

war have made the Institute a key item in national defense--no longer so able as it once was to decide how close or distant would be its relation to government. Automated industry too, makes increased demands on M.I.T. personnel and graduates.

What was an enormous site to President MacLaurin in 1916, far greater than the need, has been outgrown twice over; and urban blight, high-priced industrial land, and the Charles River are blocking further lateral expansion.

How is the Institute to meet these problems without reaching the breaking-point? Is expansion desirable, or even possible? What should be the "character" of M.I.T. fifteen years from now?

Much effort has already gone into looking for answers. A committee on educational policy has examined the curriculum and emerged with some startling new programs which are now in effect. Another group has presented recommendations for stabilizing enrollment, and a combined committee of Corporation members, faculty, and students recently completed an exhaustive study on student housing. The Dean of Engineering is probing MIT's role among American technical institutions. The Administration has decided to accept some responsibility for preserving the health of the surrounding city by declaring its willingness to participate in an Urban Renewal program for Cambridge.

As fruitful as these individual efforts have been, so far none has come to grips with the real issue--that no de-

cision should be made about a part without measuring the decision against its contribution to the total scheme of Institute objectives or without considering its effect on the whole physical plant. Only a combined, integrated study of objectives, pressures, and resources will successfully see M.I.T. through its future.

In presenting this thesis, the writer hopes it might be one step towards a comprehensive analysis of M.I.T!s problems and potential. If a great deal of time is devoted to discussing objectives for education, research, and extracurricular life, it is because the writer believes that no planning can commence unless these goals are analyzed and defined, and their background understood--because the goals are the yardsticks against which all decisions must be measured.

If a great deal of time is devoted to discussing the Institute's past physical development, it is because the writer believes that past experience gives important indicators for future growth. Through it, we can see how the relationship between objectives and environment evolved and laid the basis for the situation in which we now must operate.

Chapter I will deal with MIT's gyroscope, its objectives as culled from writings of early directors, from Presidents' Reports, and from committee recommendations. Here, as in every section of the thesis, the writer has tried to draw together many often-conflicting strands,and

he accepts full responsibility for any errors of interpretation that might occur. This is his view of M.I.T!s objectives, not an official pronouncement.

Chapter II will sketch the development of the physical plant from the old Rogers Building to the Compton Laboratory, showing how this development reflected some objectives and fell short of others.

Chapter III will examine the present physical plant and will be essentially a survey of facilities, their use, and their needs. It will also contain some analysis of the surrounding urban area, and of the area's relationship with M.I.T.

Chapter IV takes a look into the future. It will attempt to establish enrollment predictions for 1960 and 1970 based on the preceding discussion and on potential demand. Then it will examine the relationships between projected enrollment and possible increases in teaching, administrative, and office personnel. As an indication of physical changes which might occur at M.I.T., Chapter IV will also try to estimate future requirements for instructional space, housing, athletic facilities, and parking. Again, the emphasis is not on quantitative material alone, but also on how developing objectives might influence the character of a developing plant. Finally, a number of specific proposals regarding location and character of future growth will be presented for consideration.

Before ending this introduction, it is important to stress once more that the analysis and recommendations are one man's interpretations based on a few months of research. Much is omitted which should be covered by a final development plan---a thorough economic analysis, for instance, and a design solution. To do justice to the issues involved would require a team effort and whole-hearted Institute support over a long period of time. The writer hopes that this study might make some small contribution to such an effort.

CHAPTER I----THE GYROSCOPE OF OBJECTIVES

"'To the honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court Assembled:--The subscribers respectfully pray for an act of Incorporation for an Institution to be entitled the MASS. INSTITUTE OF TECHNOLOGY, having for its objects the advancement of the Mechanic Arts, Manufactures, Commerce, Agriculture and the applied sciences generally, together with the promotion of the practical education of the industrial classes, and proposing to attain these ends by the threefold agency of discussions and publications relating to industrial art and science; by a Museum of Technology, embracing the materials, implements and products of the practical arts and sciences; and by a School of Industrial Science, for instruction; by lectures, laboratories and other teachings in these several departments...

William B. Rogers, Chairman'"
(18, p 30)

"First, we are a professional school...Within the framework of these professional ideals, we seek to educate men and women who have the competence of specialists plus a sense of the first-rate which extends beyond their specialized interests...This combination of professional and general education has exceptional relevance and power for preparing men for careers of action and effective citizenship in our modern American society.

"Next, we carry on our work in the spirit of the University, including in close relationship, post-doctoral, graduate, and undergraduate learning, with the spirit of research and other forms of creative scholarship infusing all our educational activities."

(1953 Pres. Rept., p 6)*

Almost a century intervenes between the two quotations. The world, America, and technology are much changed since Rogers petitioned the Massachusetts Legislature for Back Bay land on which to build his Institute. M.I.T. has grown with the society it serves, and its initial objectives, which now

---

*All quotes from Presidents' Reports will be designated by the date and the abbreviation Pres.Rept. Other quotes will be referred to numbered sources in the Bibliography.

may seem rudimentary but were not in 1860, have changed as well.

But perhaps change is the wrong word. Actually no one word can describe the process of transformation which comes with growth. Basically, the principles are the same, but they have been reinterpreted, supplemented, and rounded through time.

Here our attention will focus on those educational, environmental, and research objectives (and their background) which seem to have a bearing on size and physical development. The actual plant and enrollment problems are deferred to later chapters in order first to clarify the framework in which they arise.

EDUCATION

In his 1952 report President Killian stated three general goals for an educational program:

"1. Maintenance of the Institute's leadership in its fields.

2. Enrichment of general education and social sciences programs appropriate to an Institute of technology.

3. The achievement of M.I.T.'s goal to become a residential college and the rounding out of our extracurricular activities to make them of maximum educational value to our students."
(1952 Pres. Rept., p 11)

While Rogers was faced only with designing a suitable curriculum for undergraduate study, the present administration has actually assumed a four-fold responsibility towards education:--providing suitable, flexible curricula for undergraduates and for graduates and fostering non-curricular opportunities for each.

curricular objectives for undergraduates

In ninety years the undergraduate school has changed from a vocational program of three "courses"* to a system offering twenty specialized programs, each heavily sprinkled with non-technical matter, with a first year schedule practically the same for all men. Eight humanities or social science courses are now required of every student, and more are encouraged. Since the freshman program is now almost identical for architects and for physicists, the opportunities to develop specific skills by graduation are less than at any other time in M.I.T.'s history. Today's graduate knows more about more things than his predecessor, but his level of technological skill is lower--relative to the height of technological achievement within the society. Despite the number of programs, specialization on the college level is decreasing.

Three factors contributed to this state of affairs. One might be called awareness of cultural inadequacy; another, awareness of responsibility to society; and a third, the changing requirements of industrial employment.

*Prescott states that the Ambitious Course IV in "Fine Arts and Ed." was always sparsely attended.

1. American society had to reach a particular point of development before the universities which trained her leaders could realize that somewhere they "missed a boat" in their cultivation of talent...lawyers and historians as well as scientists and engineers. The Renaissance Man had long since disappeared to be replaced here in the middle 19th century by the specialist motivated by a curious transformation of the Puritan Ethic and its idea of "calling". No longer was it possible, or desirable, for a professional man to cultivate other disciplines save his own during professional training. One could easily enter a law school or a medical school directly or with a year or two of previous higher education...and even this period was largely spent in meeting occupationally-oriented prerequisites. Even many of the so-called liberal arts colleges offered limited, rigid programs, and it was not until the 1880's that President Eliot, twenty years removed from his professorship at M.I.T., inaugurated an elective system at Harvard.

We hear a lot of talk today about over-specialization, while actually all a student could do a generation or two ago was specialize...and early. As our industrial supremacy became established, however, a new kind of thinking emerged. Society started to ponder not only about how to build better mousetraps, but why---less about how fast it was going to go places and more about how it got here in the first place. A search for stability, for roots, for direction inside the

industrial-financial cosmos we had created about ourselves, led educators towards a new emphasis on broadening the scope of their programs.

"(Education) must not only train men who can do the complex, specialized work of society, but...must cultivate a reverence for the dignity of the individual."
(1949 Pres. Rept., p 9)

With scope as a goal, universities like Harvard, Yale and Chicago developed "General Education" programs requiring students to dip into many fields before or during specialization. A new conception of undergraduate education appeared, most eloquently stated in the Harvard Report, "General Education in a Free Society". This was the now-famous notion of the "Whole Man", the 20th Century Leonardo, not necessarily proficient in a number of fields but at least cognizant and understanding of them.

At M.I.T. the whole man notion was first applied to the purely technical community. It began under Dr. Compton with an increased emphasis on the existing humanities courses and reached its peak of influence but recently when the School of Humanities and Social Studies was elevated to equal status with the other four, and when course XXI offering degrees in Economics and Science and Humanities and Science was established in 1955.

2. Awareness of cultural inadequacy was not the sole motivation for liberalized learning at M.I.T. While this motive recognized a lack in the past, a second goal was

geared more towards anticipating a future requirement--social responsibility on the part of scientists and engineers.

> "...This concept of ministering to the public welfare, which is the concept underlying the professional attitude, is the remaining principle that needs to be fully synthesized with the other elements that have been combined to form the engineering philosophy. If we are to be a true profession, we must embrace this third dimension of social responsibility and public service." (9, p 57)

When the Institute began, industrial control rested with the entrepreneur, the developer, whose major purpose was to accumulate capital to amass employees to run the machines scientists developed. While the scientist was in the forefront of human achievement, he was in the background and subordinate as far as actual social control was concerned..

More recently, ownerships have become diffused among a large number of stockholders, and the one man or one-family system of direction is giving way to the "generation of managers", the professionally trained administrators who are engineers as often as business-school graduates. These scientists do not labor in isolation, but their contact with and responsibility to the public are both direct and continuous.

Direction by the technician holds not only in large, established corporations like Monsato or Bell Telephone, but in new, "growth" industries as well, which are often begun by a revolutionary advance in electronics or chemistry.

Two developing arenas for scientists where social contact may be weak but public responsibility huge and pressing are in government research and public opinion formation. It is unnecessary to review events of recent years that make research and development guardians of national defense or that cause the scientist to become the most vocal, as well as most informed, spokesman against nuclear war. Journals like the "Bulletin of Atomic Scientists" and unfortunate incidents like the Oppenheimer case bring the scientist to the public's attention. He has become an important molder of contemporary attitudes.

Through making humanities and social studies courses required for all, the Institute believes much of this sense of responsibility can be inculcated.

3. The third and perhaps most specific motivation for stressing non-technical learning in today's Institute is that industries now want their young employees to possess "breadth of thought" in addition to technical acumen. In the same way many medical schools now prefer students who majored in Sociology to Biochemists, industry looks for the man whose problem-solving ability and discrimination have matured through breadth of study.

> "His capacity to make sound qualitative judgments should be developed so that he may distinguish that which is good from that which is mediocre."
> (1*, p 17)

---

* A report by the American Society for Engineering Education.

Karl Compton articulated the rationale behind the new liberal look in the following way:

> ".....we do not want to differentiate this aspect of our educational program too strongly from the professional aspect. They are really all parts of a unified program aimed at developing a man who will be a competent operator in some field of specialization and who will at the same time have the insight, appreciation, and viewpoint which will enable him to find interest, to operate effectively, and to live with satisfaction in whatever community or situation he may find himself. This is a very large order. Obviously we cannot achieve it wholly." (9, p 56-7)

Perhaps the writer may be accused of devoting too much discussion to non-scientific objectives in a school whose reason for existence is scientific education. These objectives, however, have been the most profound influence on the Institute's program since the war---and, as Chapters II, III and IV will illustrate, their realization has been the most important consideration in M.I.T.'s building activities over the last seven years--witness the auditorium and chapel and their impact on future construction will be large.

One might say that the position of humanities and social studies in the undergraduate curriculum is now stable and secure. What remains is to pursue the stated objectives through the framework presently in operation. But re-evaluation never stops and the Institute is on the threshold of another new development in undergraduate curriculum cut from the same cloth as the last. Here the goals have been defined, the pressures to implement them are enormous, and the implications for the existing departmental structure and physical plant are far-reaching.

Integration and the combined efforts of various disciplines on a specific project characterize contemporary scientific methodology. The latest advances in electrical engineering, for instance, required the cooperative undertaking of physicists and mathemeticians as well as electrical engineers. When the architect talks of solar-heated houses, he knows that his very design must depend on intimate cooperation with sanitary and mechanical engineers. Even the industrial location economist is at a loss without the advice of a chemist and the solid foundation of mathematics.

In its research activity and in its graduate program (see below), MIT is at the head of this integrated approach. However, both the Institute and industry feel that preparation for integrated effort should begin at the undergraduate level instead of waiting until advanced study or on-the-job experience. Preparation for integrated effort requires more emphasis on the fundamental scientific tools of mathematics, physics, and chemistry, each of which has made enormous strides in recent years--an emphasis sufficient enough to give the student more than an acquaintance with basic concepts...rather an intuitive understanding of the possibilities and limits of these disciplines. By nature of the objective, this means even less undergraduate specialization.

The adage about nothing being new under the sun applies to recognition of the need for more basic science at M.I.T. Back in 1929 the President's report stated:

"Instructors in the fields of technical education generally recognize the importance of sound training in the branches of mathematics and science fundamental to all technical courses. That they have too often failed in bringing about a satisfactory adjustment between the basic and applied subjects both as to quality and quantity must be admitted." (p 9)

For the contemporary view of both academicians and industrialists we can turn to the "Report on Evaluation of Engineering Education" published in June,1955 by a committee of the American Society for Engineering Education, of which Dean Hazen was a member.

"The great changes in physics and chemistry over the past thirty years and the equally great advances in engineering practice do not seem to have produced and equivalent counterpart in a reorganization of engineering curricula. A group of industrial advisors to the Committee has pointed out that the problems in production and manufacturing are now demanding greater and greater scientific background for engineers"

and (1, p 19)

" This translation of new scientific developments into engineering practice will be facilitated by emphasizing unity in scientific subject matter. For example, there is a great deal of similarity, both in conceptual understanding and in analytical methods, among the generalizations of heat flow, mechanics of fluids, electromagnetic fields, and virbartion theory. When a student understands these generalizations, he has gained a concept of systematic orderliness in many fields,of science and engineering; he is therefore able to approach the solution of problems in widely diverse fields, using the same analytical methods." (1, p 12)

and

" The industrialists emphasized that their sales, manufacturing, operation, and maintenance engineers need strong scientific backgrounds just as much as do their research and development engineers and their designers. They were unwilling to sacrifice courses in engineering sciences to provide time for the study of technology or administration at the prebaccalaureate level, since they believe that these can be obtained under company sponsorship when needed." (1, p 21)

A time lag between the emergence of a new idea and its implementation is the rule rather than the exception. While

the need for more basic science was stated at M.I.T. in 1929, many years passed before its awareness actually filtered down. It will still take time before a position here is sharply defined, but the time draws closer.

"We continue to witness an increasing emphasis on fundamentals...the injection of more science into the engineering curricula."
(1954 Pres. Rept., p 19)

We can only speculate on the changes such a policy would create. The most obvious is another decrease in the time devoted to specialized studies. Others may be mergers of various related fields--recently illustrated by the combination of building construction with civil engineering--The Schools may become more important than they are now, with a decreasing emphasis on specific programs within them. This development was intimated by faculty and administration representatives at the Endicott House Conference on the future of the Graduate School in November, 1955. Another result may be increased staff and importance for the already overworked math, physics, and chemistry departments.

Some such changes are inevitable. If they go into effect in the near future, combined with the new emphasis on liberal education, they will bring about a complete transformation from the Institute of 1916 or even of 1945. We can expect a completely new, essentially non-vocational brand of technological training, a university based on science---although specialization probably will never be eliminated. Here will be the broad base essential to a

a creative scientific career.

"If we can achieve such intellectual integration, "President Killian says,"the basic conflict between general and specialized education will have been removed."
(1949 Pres. Rept., p 9)

One of the Institute's goals which has remained a solid guidepost throughout this re-thinking of curricular objectives is the concept of "learning by doing"--a concept that requires a more extensive set of undergraduate laboratory facilities than would be necessary under a purely theoretical system.

It was not Rogers but Runkle who first put this idea into practice. Prescott states that Runkle's most important contribution was to stress "experience in laboratory, shop, and field as a necessary supplement to the study of principles of science and engineering."
(18, p 95)

In 1869 the first in-service training program got underway as some students started working at the Charlestown Navy Yard. Soon afterwards summer field trips began, now an important aspect of the geology curriculum. Chemical engineering adopted its practice schools at Parlin,Buffalo, and Bethlehem--for undergraduates as well as graduates. With the machine tool lab and later (1952) the Alfred P.Sloan Metals Processing Laboratory,college year students received

an excellent opportunity to practice on machine development. Teams work on actual design and fabrication projects, and through the cooperation of several industries in the Boston area, others have been able to take existing pieces of equipment, break them down, and develop new, more efficient instruments.

> "By bringing down into the undergraduate school more of the creative research and professional attitude of the graduate school, we have been seeking to do a better job of teaching engineering and science to undergraduates."
> (1953 Pres. Rept., p 14)

Doubtless we can look for more "learning by doing" in the future. How it might adapt itself to the growing emphasis on scientific fundamentals is illustrated by Professor John Arnold's course in mechanical engineering, where students are asked to free their imaginations and design unusual equipment for the Planet Acturus I whose atmospheric conditions and human forms are different from those on Earth.

The following statement on "learning by doing" at M.I.T. by Dr. Killian will be of great importance in subsequent sections of this report.

> "In both graduate and undergraduate study and in our community life, the Institute stresses 'learning by doing'. This is more than a phrase; it is a philosophy of education. It means education for action. It means a feel for materials, an experimental attitude, theory tested by reality. It means emphasis on laboratory instruction, project courses, small classes, 'whole' problems, practice schools, student self-government, and other activities whereby the student develops judgment and experience through practice."
> (1953 Pres. Rept., p 9)

---

graduate curricular objectives

"It is furthermore absolutely necessary that the Institute should foster such work for the sake of its prestige, because the graduate students are in general the most highly selected group, because their presence is a stimulus to and an incentive in holding outstanding members of our staff, because the atmosphere created by graduate students is stimulating and illuminating to the undergraduates, and because statistics show that the rapid development of postgraduate work is nation-wide....

On the other hand, postgraduate work has a relatively high percapita cost and its value is not measured in terms of size of enrollment, but rather in terms of quality of achievement." (1931 Pres. Rept., p 13)

As important as these words of Dr. Compton were in 1931, they have even greater significance today. "M.I.T.'s continued progress", said one administration official, "depends on what we do with the Graduate School."

Here again we can observe a set of objectives, which could not have been presaged in Roger's day. There was no graduate instruction at Tech until the late 1800's and no significant number of graduate students until the middle Twenties. Thirty-six percent of the present student body is working for advanced degrees, and Table A1* and Graph A1* best illustrate this relative shift in emphasis over the years.

An expanded graduate program logically followed from the increased scope and sophistication of technology. Somewhere in the Twenties, it became apparant that the leaders of scientific achievement could no longer depend on a four-year education alone, and graduate training in all insti-

*All Tables prefaced by A are in Appendix.

tutions of higher learning took on heightened importance. The new look in undergraduate training, pioneered by MIT, brings added impetus to providing opportunities for graduate work. Now that the four-year college program will concentrate on providing a broad base of knowledge, the graduate school will be responsible for translating that base into specialized, "professional", achievement.

"The growing complexity of modern technology has forced MIT to adopt a new attitude towards the amount of education required for professional scientific competence. While some men can be successful with only a Bachelor's degree, the administration feels more and more advanced training is necessary to keep up with technological change. The undergraduate will gain a broad background of scientific training, but only a graduate student will be able to develop these fundamentals into unique skills and ideas."
(20*, p 3)

"The four-year program, even with increased scientific emphasis, simply cannot provide the depth and breadth of scientific foundation and the background for creative thinking in design which are needed. The need for graduate education varies with the rate of advance in the use of science characterizing various fields of engineering; it is greatest in those fields in which this rate is most rapid or to which science can contribute most directly. Industry places a substantial value upon graduate education, as indicated by recruiting efforts, salaries, and advancement to positions of high degrees of responsibility. Furthermore...engineering education must be based more and more on a profound knowledge of the basic sciences and so will require that an increasing proportion of its teachers will have the benefit of advanced graduate education"
(1, p 27)

Whether or not this policy commits the Institute to increase the size of its graduate enrollment will be discussed in chapter 5. In terms of objectives, however, the adminis-

---

*"Harvard Crimson" article.

tration is committed to maintaining standards of excellence and branching into new uncharted fields (i.e., industrial management) when opportunities arise and resources permit.

The post-doctoral investigator, for instance, is an increasingly familiar figure around the Institute. Now not even a Phd. is enough for those on the frontiers of scientific progress. In line with the Institute's objective to be among the first on those frontiers, M.I.T. recently formalized the post-graduate program under a Center for Advanced Studies.

"Learning by doing" is perhaps even more vital to the advanced program. The Institute encourages men to participate in research almost immediately--research which acts as an incomparable educational tool as well as a means of financial assistance. Witness the 850-odd part-time staff members---research assistants, fellows pursuing special interests and teaching assistants.

To carry out both the policy of "professional" training and graduate research, the Institute has created several interdepartmental research centers. (See page 34)

"Certain institutions have tried to meet this problem by setting up special institutes, others have set up new departments. Both of these solutions seem to us to be lacking in two desiderata, namely, the mobilizing of the interested personnel in various departments into a cooperative effort, while still recognizing each department's special interest in various aspects of the program, and the full co-ordination of the research with the educational program."
(1946 Pres. Rept., p 22)

Graduate training makes a greater strain on academic

facilities and personnel. It "should be flexible and custom tailored to suit the individual" (EE report, p 31). It requires more faculty student contact, both direct and sustaining, than during college years. At the same time, it means more laboratory and shop facilities per man. It therefore means more expenditure per student.

While these men assist in research and undergraduate instruction, they demand a great deal from the Institute, and any decision as to continuing the trend towards a larger graduate enrollment will have to consider carefully these demands.

the non-curricular side

Attitudes and objectives focused on the non-curricular side of student life at the Institute are undergoing a profound transformation. In fact, early administrations had few attitudes (and less objectives) about what educators now loosely call "personality development." While General Walker sincerely tried to provide adequate athletic facilities, and while he and subsequent Presidents encouraged outside activities and organizations, their efforts moved largely in a vacuum. Even the dormitory system was conceived primarily as a means to house men close to their work, not as a milieu for developing a particular brand of collegiate environment around which clubs and activities could be oriented. Contrary to the experience of most other universities, an "esprit de corps" based on common interests and close faculty-student contact developed more in the two Graduate Houses (East Campus and the present

Grad House) and fraternities than in undergraduate dormitories.*

But now officials consider environment, organizations, and athletics educationally valuable. This relatively new way of thinking stems from the same set of motivations which brought about a liberalized curriculum, extended somewhat to a concern for the student's emotional development. The "whole scientist" must be a rounded individual. He must pursue his education in a sympathetic intellectual climate and in an enriching physical environment, with opportunities to refresh both mind and body through participation in social cultural, and athletic programs. Neither climate, environment, nor outside activity is considered as an end valuable in itself, but as an educational tool, thus justifying Institude sponsorship. These basic goals are the same for graduates and undergraduates, but methods of approach will differ.

Institute policy on non-curricular life is still very much in the process of definition. Some important areas are not yet clarified, and at this point there are still significant contrasts between purpose and practice.

---

* The fraternity system has tended to bring a sense of identification to its undergraduate members (perhaps because many live in the same small unit for most of their four years) but this is something which developed essentially outside of Institute policy rather than a result of it---even though fraternities are more a "part" of MIT than of most schools.

undergraduate concerns

some background

In 1926 the Dean of Students made a strong indictment of the intellectual climate:

"There is definite evidence that an appreciable proportion of our students consider that the general atmosphere of the Institute is one of coldness...Unfortunately this reputation for coldness seems to be spreading to our disadvantage. Unquestionably this alleged lack of cordiality is occasioned mainly by the scattering of most of our students and all of the instructing staff as soon as the work of the day is accomplished. There is too little contact of instructor and student outside of the classrooms and laboratories, and insufficient contact among the students themselves...It is a serious handicap to effective teaching."

(1926 Pres. Rept., p 47)

Twenty-two years later, the Committee on the Educational Survey found that the situation had changed but little:

"...the classes are impersonal; the environment is graceless and illiberal; the students are so overloaded with routine work that they have no leisure for reflective thought or for the social and cultural experiences which are necessary for proper intellectual and social growth."

(7, p 25)

Residential location of students and faculty is still a big cause of impersonality (See maps 4, 5, 6, 7, Chapter III) and only 1,800-odd undergraduates live on campus,(less than half, compared to 87% at Harvard), close to Institute facilities while the rest are scattered over Boston and the metropolitan area. Although a significant number of faculty members have homes in Cambridge, the residential section of the city is far from the Institute, and most staff members live in outlying communities. MIT has tended to be a 9-5 job for instructional staff and a place to go to class and

work in labs for undergraduates.

Another factor contributes to the Institute's climatic difficulties -- the emphasis on professorial research -- and here lies the most difficult-to-resolve policy conflict of all. TableA2 shows that MIT has consistently had a very favorable student/faculty ratio (a good deal higher than that at Harvard, for instance). But faculty student contact, even given the difficulty of residential dispersion--suffers more severe handicaps than necessary. One senses that professors would rather spend their time on research than in informal contact with students. Research and furtherance of professional stature have perhaps been more deterrent to good student-faculty relationships at MIT that the "publish or perish" system at Harvard, where an extensive house resident and tutorial program guarantees that all men can know some instructor well.

Faculty-student relationships and student activities like the Tech, Voodoo, INSCOMM, and Athletics have developed rapidly over the last few years due to the new Institute policies articulated below. But it will take a long time before traditions grow, before activities become part of a unified "university" atmosphere instead of being fragmented, isolated achievements, and before the end product is consonant with the new objectives.

the new goals

Creation of an undergraduate "life" at MIT began with

the Committee on The Educational Survey's report in 1949. After assessing the need the committee concluded.

"For undergraduates, particularly, we feel very strongly that the scientific spirit of inquiry and a liberal approach to life can best be acquired by living within a genuinely creative atmosphere. Therefore, we suggest as a goal, the development of a physical and intellectual environment which will provide M.I.T. with a life of its own within the larger life of the metropolitan area." (7, p 132)

The Carpenter Committee on Student Activity was somewhat more specific about the reason for environmental changes.

"The boys who are most interested in science and engineering are all too frequently the very ones who are most in need of the broader personal contacts offered by college dormitories, a campus, and atheletic fields. Without these facilities a retiring boy may develop into a competent but retiring scientist; with them, however, he might still be a scientist but in addition become a leader in his field. We are convinced that there is a real need for greater development of human understanding and warmth of personality at Tech." (6, P2- 3)

As a first practical step, the administration set out to improve the climate of faculty-student relations. Establishment of a residential college, where students and their activities could have a "home" was taken as a long-term goal.

student-faculty relations

Soon after the Educational Survey Report, the Undergraduate Policy Committee was established to examine all matters of undergraduate affairs in cooperation with the dean's office. Under the UPC, functions a Student Environment Committee, primarily concerned with a continuing appraisal of "atmosphere" and non-curricular activities.

Since 1951 a faculty resident has lived in East Campus and the two dormitories on West Campus. While disciplinary measures are left to the House committees, the resident is to act as friend and counsellor to the students, and there is much discussion about increasing the number of faculty residents and broadening their responsibilities.

Under the relatively new Advisory Program, each freshman has a faculty counsellor who is in turn responsible for 15 students. (The custom of senior thesis advisors is well established,and sophomores and juniors are assigned to departmental registration officers with varying success.) Through the Freshman Weekend, Dean's Office activities, and special student-Administration conferences, Administration and students have established better rapport.

As a first approximation of an ideal state-of-affairs, these efforts are highly successful; yet the Institute has far to go before student-faculty contact is on a really direct, universal, sustaining, and purposeful basis.

the residential college

Physically a residential college means a dormitory system integrated with educational and athletic facilities. It means that in the dormitories or close by will be facilities for a wide range of extra-curricular activities. Within this arrangement a way of life should develop based on an intellectual pursuit and framed by students, faculty, and Administration

together.

"M.I.T. is a big school, composed of 20 academic departments, over 3,000 undergraduates, and almost 2,000 graduate students, and a total complement of over 11,000 people. The majority of the faculty and staff commute to work. In order for any student to have a sense of belonging in this large community, he must have both an intellectual home (his department) and a physical home (his dormitory, fraternity, or commuter's center). By becoming an integrated, participating member of his dormitory, he thereby becomes part of the social civic community of M.I.T. By becoming identified closely with his department, he feels at home in this community of scholars. By building bridges between the two, the dormitories and the departments, we all become increasingly loyal members of a great institution." (5, p 1)

These are MIT's objectives. As yet, however, there has been no decision as to the number or percentage of undergraduates to be housed. The Institute does not believe in making campus residence compulsory for upperclassmen, but we do not yet know whether the ultimate residential college will be designed for most or only a sizable fraction of the undergraduate body. We do not know how the fraternities might be affected by such a system. Nor is it evident whether or not the administration might modify or broaden students' responsibilities for dormitory conduct and operation in order to develop what Dr. Farnsworth calls "built in controls".

"Rather than relying on the guiding influence of home, we should build upon those influences which are helpful and try to create an environment in college in which self-control is looked upon with the highest approval." (11, p 143)

<u>student government</u>

MIT is one of those all too rare institutions which believes in allowing its undergraduates a maximum of self government. Before the present re-evaluation period, self government

tended to operate in limbo. Aside from Dean's Office assistance, it took the place of active participation by faculty in student affairs, and for this reason--lack of direction and "professional" help--may not have achieved the success it deserved. Nevertheless, organizations like INSCOM, IFC and the House Committees have provided valuable service functions as well as outlets for student interests. The Administration does not believe in encroaching on the area ceded to student government, and its objective is to further these activities. Now with faculty interest growing and with student representatives participating in administration policy discussions (viz. the Ryer Committee), opportunities for cooperative effort are stronger.

athletics

Athletics have been an important part of undergraduate activity since before MIT moved to Cambridge, although sufficient gymnasium facilities have never been available. The Institute's athletic policy may best be described by quoting this somewhat amorphous statement of objectives by the Athletic Review Committee.

" 1. M.I.T. seeks the maximum possible participation by students in the athletic programs of the Institute, with a proper balance maintained (as at present) between intercollegiate and intramural sports.
2. M.I.T. seeks the best leadership and facilities for athletics.
3. M.I.T. emphasizes the higher physical, intellectual, and spiritual values to be found in athletics--the true pleasure of a good game well played as contrasted to the drudgery and distraction of games played under the pressure of compulsion or over-emphasis.

" 4. M.I.T. seeks to win and to foster a smoothly functioning team spirit within the limits of time imposed by a busy academic schedule and a well-balanced college program.
5. M.I.T. believes that wherever practical and possible, control and management of all athletics be in the hands of students, with coaches, alumni, and administration readily available for advice and counsel.
6. M.I.T. recognizes athletics as an integral part of college education for the great majority of undergraduates and, therefore, clearly recognizes the responsibility of the Faculty for the amount of time allotted to athletics and for the general nature or tone of the program; and the responsibility of the Alumni, Administration, and coaches for the maintainance of traditions and standards of management and participation worthy of M.I.T." (2, p 2)

Briefly, this means encouraging, though not demanding, athletics for all through intramural sports and intercollegiate athletics but not to the detriment of the educational program.

other activities

Student publications, drama groups, professional societies, etc., are getting an increasing amount of official encouragement, but now many of them must meet in empty classrooms. Here the administration has a specific objective as stated in several Presidents' Reports--provision of adequate facilities for meetings and headquarters in a student center.

areas lacking definition

No specific objectives cover integration of commutors and women students with the rest of the Institute. Walker Memorial is inadequate and, from the Student Environment Committee report of 1955, we do know **there is a desire**

to decrease the isolation of commuters. But there is no indication whether special commuter facilities or facilities combined with a student center are considered preferable.

MIT admits women students, but does not encourage them, and thus has a very small feminine enrollment. Without a dormitory system of their own and without access to many of the opportunities provided the men, these girls are isolates within the community. True, most of them come for a specific purpose and not to enjoy a gay college life, but this is perhaps all the more reason why their interests, environment, and personality development should be cared for, yet they have fewer advantages here than in almost any other coeducational arrangement. A crowded 17-girl house is no place to learn "gracious living". The Institute has no firm or developed set of goals at this time about the future of women students.

Both the commuter and the coed problems will be treated at length in Chapter IV's discussion of expansion alternatives.

graduate extracurricular concerns

The Institute has not had to make such thorough policy re-evaluation in regard to graduate students, because the atmosphere presents them with fewer problems.

Faculty-student relationships are closer by nature than for undergraduates. Classes are smaller, and as the men begin research activity, they establish strong rapport with individual

professors. There is also some indication that professors would rather spend time with students who are involved in professional work of interest to them than with undergraduates at the bottom rung of the ladder.

Then, too, the graduate is perhaps better prepared for this somewhat mechanistic, work-oriented environment. He tends to be more mature, more able to utilize freedom from restraint productively, and better able to cope with the environment because it provides him with means of carrying out his own formulated objectives. The graduate usually has been able to establish foundations of "personality development" in an undergraduate school first.

Many wish to live elsewhere in apartments, free from anything approaching surveillance, and for those who can live on campus, the Graduate House provides a pleasant blend of freedom with a compatible community...due largely to Dr. Ashdown who has been faculty resident since 1933.

Some important problems exist, however, and the Institute has framed objectives around them.

The first may be called orientation-identification. How can the graduate students develop a sense of identification with the Institute as more than just a place where one labors in a lab or gets a degree? The second is unification. How, without coercion, can the graduate students broaden contacts with each other and gain a sense of unity as a student body? A third objective is to increase informal faculty-student contact and a fourth to provide more opportunities for extra-

curricular activity, especially athletics, realizing all the while that this sort of endeavor is of less importance than in the undergraduate school. A final objective is to improve graduate student housing, although administration policy seems to be that this is secondary to establishing an undergraduate residential college.

Married student housing, pioneered by MIT with Westgate and Westgate West, is to be put on a permanent basis. Yet there tends to be a general feeling that only those who cannot afford other living arrangements should be accomodated.

----- ------ -----

RESEARCH AND COOPERATION WITH GOVERNMENT AND INDUSTRY

At one time it might have been possible to discuss these two sectors separately, but now, since most research is sponsored by government and industry, they must be treated together.

Teaching was the primary job of Rogers' Institute. While research activity began soon after the school was established, it took the form of what Dr.Compton called "unrelated" projects until well into the 20th Century. The Institute had little enough money to devote to instructional facilities, let alone research, and individual professors would carry on individual projects when they had the funds.

When MIT moved to Cambridge, not only was financial need more acute, but facilities for extensive research activity were now available. Despite much adverse comment abat "sell-

ing out" to industry, President MacLaurin created the now famous Technology Plan and DIC--"The first complete scheme ever worked out by a technical institution in cooperation between a school of pure and applied science and the industries dependent on this science'" (7, p 51) Individual professors still worked on individual projects, but now the purpose and contract tended to be specified and the time devoted to investigation rather than teaching increased.

The very low students/professor ratio, which appeared in the thirties,indicates the beginning of a now common practice, appointing some faculty primarily to conduct research. It was also in the thirties that group activity came into its own.

"In addition to the individual and often unrelated nature of many professors' lines of professional interest, there is a healthy and very productive tendency to develop programs, either within departments or involving interdepartmental cooperation. Our arrangements facilitate such enterprise. In fact several of the most important of these new programs involve close cooperation with neighboring institutions, industrial groups or governmental bureaus." (10, pp 4-5)

"We have in the size, quality, and diversity of our staff and in the close knit organization of our laboratories under one roof an opportunity for cooperative effort which is probably unequalled in the world." (10, p 1)

The war and weapons developed for the government established the cooperative program as the major type of research at the Institute, and it also made Washington the major source of operating funds.

Since 1945, MIT has concentrated on developing integrated, interdepartmental, research laboratories, some of which can now be considered permanent additions--the Research Laboratory

of Electronics, the Center for Analysis, the Acoustics Lab, the Instrumentation Lab, the Servo-Mechanisms Lab, and the Laboratory for Insulation Research.

"Because MIT has a versatile and integrated team, it has unusual competence to do comprehensive "systems" research,and many of our staff feel that is one of the most important contributions we can make to defense." (1950 Pres. Rept., p 10)

Individual projects are still encouraged, but we can expect "systems" research to become even more important in the future. Both industry and government depend on such effort.

At one time there was no trouble justifying undertaking as much research as possible. Now, however, there are significant conflicts which the Administration is trying to resolve.

1. Does extensive research contribute to or detract from educational objectives?

In 1938, Dr.Compton could say--"These programs conform doubly to our charter, for they are integrally incorporated into our educational work with advanced students, while at the same time they are devoted to 'advancement, development, and practical application of science.'" (10, p 5)

It is true that graduate students now have greater opportunities to work on the frontiers of science and develop the integrated approach so much in demand. And, according to the Dean of Engineering, projects like the Insulation Lab, although wholly sponsored by the government, contribute much to fundamental understanding of scientific principles.

But the demands on professorial staff and Institute facilities have been tremendous. As a result the Administration now hires special DIC and DDL personnel for the particularly large outside projects like the Instrumentation Lab and Project

Lincoln and encourages Professors to act more as directors than full time participators. "We are seeking every possible safeguard, including segregation of the large projects from the normal operations of the Institute." (1952 Pres. Rept., p 31)

Evidence of this policy may be seen in the location of Project Lincoln in Lexington and the segregation of special DIC and DOL activities in the Barta, Whittemore, Kraft and Hood buildings on the west side of Vassar Street.

2. The Committee on the Educational Survey also worried about spending too much time on applied research and not enough on pure science and recommended: "the development of new devices may lead to competition with industry unless great care is taken to change the direction of these research and development activities when they no longer fill a unique need." (p 64) The Administration agrees with this philosophy, DIC activities have actually leveled off during the past three years, and the Assistant Director does not envision any sizable increase.

3. Classified projects in themselves bring conflicts of principle. They are the largest single sector of research effort and the greatest source of income and expenditure. To carry on classified research goes against MIT's belief that the results of scientific achievement should be available to everyone and that such achievement should not be conducted in

secrecy. Other institutions have refused to do classified research in peacetime, feeling that such activity cedes a measure of policy control to the government. MIT has swallowed this principle to some degree and believes "the most insistent and commanding intellectual problem of our period (is)..an inescapable demand upon scholars and educational institutions to serve the national defense and strengthen the free world." (1954 Pres. Rept., p 9-10)

The strength of this belief is indicated by the following statement made by President Killian during the Korean war.

> "Our programs and our planning at the Institute are subject to change without notice. The only policy that we can be certain is sound is to keep ourselves in a state of readiness to serve our nation, which must now mobilize its might as the surest way to prevent a war as well as to maintain the essential condition of our defense...keeping ourselves in a state of readiness means that we should try to avoid commitments that later might prove to have low priority." (1950 Pres. Rept., p 1)

The Institute has responded to this conflict of principle in two ways:

1. By creating the Division of Defense Laboratories whose job is to coordinate all government sponsored non-DIC research and segregate it from other activities. Segregation here is considered even more important than for industrial sponsored work.

2. By giving more concern to a liberalized curriculum and stress on values as well as techniques. "We have an unusually urgent responsibility now to stress the true character of science as a liberalizing, humanizing, and creative force that serves man spiritually as well as intellectually and practically." (1954 Pres. Rept., p 15)

SUMMARY NOTE

MIT's chief objective has always been education of highly-trained engineers and scientists, but recent history has driven home a realization that "vocational" instruction alone is insufficient to meet society's needs.

For undergraduates, vocational instruction is now heavily saturated with work in the Humanities and Social Studies. Soon specialization may decrease even further as a trend towards more training in basic science is formalized. A liberal education, rooted in science, is becoming the major aim of undergraduate policy.

The graduate school, on the other hand, is now the main locus of "professional" training, in response to the need of government, industry, and technology itself. "Professional" training has come to mean not merely specialization, however, but also introduction to combined, integrated study of several fields which bear on a single problem. "Learning-by-doing", or laboratory work and on-the-job training, are important aspects of both graduate and undergraduate programs.

Concern with a liberal education in college has extended to improving the undergraduate environment and extra-curricular life by laying increased emphasis on close student-faculty contact, athletics and outside activities, and on the establishment of a residential college. In graduate affairs, too, although not so heavily, the Institute is fostering "community identification", better housing, and outside interests.

Research was not too important in MIT's early history, but now it is of great significance and the chief source of operating income. Interdepartmental coordinated projects seem to have taken prededence over individual, limited investigations, and they point the direction of future research efforts and graduate training programs. Conflicts arise, however, between research and educational aims, and the segregation of classified government work is one of the main techniques the Institute is using to resolve these difficulties.

When an institution reaches the size, complexity, and importance of MIT, it finds itself operating in a number of areas where change is constant, where some policies are not precisely framed, and where others collide. This is to be expected.

Chapter I has attempted to pin down many of MIT's objectives, to examine some of the conflicts, and to point out areas yet undefined. Chapter II will move on to discuss the development of the physical plant within which the objectives operate.

CHAPTER II---THE DEVELOPMENT OF A PHYSICAL PLANT

A technical university is unlike Aristotle's Academy, which could function successfully in the simple milieu of a garden. To achieve its objectives, a technical university---or any university for that matter---must operate within an efficient, functional plant which meets highly specialized needs. Our major concern is not with design, therefore, but how effectively the plant met the needs at different periods in MIT's history.

This chapter will attempt to answer four questions: How much conscious, long-term planning as distinguished from sudden decision making has been involved in programming construction? Have there been systems of priorities, and what kind? How have new objectives affected programming for plant development? Have there been any unifying concepts behind ordering of uses on the two sites (Boston and Cambridge)?

Development itself seems to have passed through four different periods: A. The Boston Period, 1865-1915, and three Cambridge Periods, B. 1917-39, C. 1940-45, and D. 1946 to date. While the discussion will be chiefly chronological, a summary analysis of each period has been prepared for the reader's convenience:

The Early years

MIT's physical plant has been completely consonant with its objectives during only one brief period--the early years of Roger's administration. Strange, isn't it, to contemplate $34 million worth of buildings today, almost half of which was erected since 1945, and realize how many needs are unfulfilled? In one way this is an indication of how far the objectives of the modern Institute have outstripped the old... and in another, it indicates the depth of Roger's genius, because he knew what he wanted and saw his hopes realized.

> "President Rogers personally gave special attention to the interior arrangement of rooms to be used for instruction (in the first building). A commodious basement provided for the work in chemistry and mining, and five floors above the basement housed all the other departments of the Institute." (18, p 55)

At this beginning stage, MIT was limited to providing instruction in different technical disciplines--not research, recreation, or residential facilities. The Rogers building was perfect for the 69 men of the entering class.

A glance at the floor plans of the first two stories will show that each field had an area for itself--a special lecture room and adjacent laboratory where required. Almost the entire third story was devoted to architectural drafting rooms, the musea and libraries had the half story floor below, professors' studies were concentrated on the top floor; the large auditorium had a central position; and administrative offices enjoyed a prominent, controlling location at the entrance to the building.

MIT's home was harmonious with what MIT wanted to be--a

harmony which exhibited itself externally as well as internally.

"The building was an imposing one, a notable example of classical architecture well suited to the needs of the period. Seventy years later, Walter H. Kilham '89, in his admirable book, Boston after Bulfinch, wrote of these buildings*, 'the harmony of these two buildings set a fine example of regularity in Civic architecture which unfortunately was not generally followed.' He called the Rogers building "stately' and all those whoever mounted the imposing granite steps and entered the spacious and dignified interior will agree." (18, p 55)

Rogers no doubt anticipated growth, but he could not predict how much. MIT was the first of its kind, and no past performance could lay the basis for future plans. In these early years the Institute owned what seemed to be a sizable portion of the newly reclaimed Back Bay--about 80,000 square feet, the land between the Museum and Clarendon Street, bounded by Newbury to the North and Boylston to the South--and the Rogers building occupied half the site.

Map 1 shows the site plan of the Institute as it looked in 1904, and the reader can use this plan to locate each new building as it was erected.

The Rogers building functioned by itself for eleven years (although a single story drill shed gymnasium was placed on Clarendon Street in 1875). Meanwhile new programs came to supplement the original ones. A school for Mechanic Arts was inaugurated as well as a women's laboratory offering a special S.B. degree to those few females who had technological leanings.

The main building was becoming too small, but lack of funds hindered any extensive projects, and so an "annex" was

*Rogers and the Museum of Natural History, now Bonwit Teller.

put alongside in 1876 to house these two new activities. It was a flat-roofed, one-story, red brick affair of only 5,000 square feet and looked pretty grim beside its neighbor. It was torn down six years later.

When General Walker became President in 1881, he found an enrollment of 300.

"The physical plant consisted of the main building on Boylston St., which was already crowded; the one story brick structure (it could hardly be called a building) built by President Runkle which was outgrown and totally inadequate, and the drill shed at the Clarendon St. end of the block. There were no funds for further building on the Boylston St. site." (18, p 132)

Nor was there opportunity to build on adjacent land. The Back Bay boomed, new structures arose all around the Institute, and Tech, with neither funds nor the ability to judge future growth requirements,was handcuffed as far as expansion was concerned. At this point the greatest space need was not to start new programs, but to accomodate the increased enrollment in existing departments....and pressures were enormous.

The Institute did acquire some land adjacent to the site of Trinity Church, but no one considered that laboratories next door would be beneficial to church or Institute, so MIT sold the parcel. With this money, Walker began a new building parallel to Rogers on Boylston St. He had to move the drill shed, which now served primarily as a gymnasium, and could not be too particular about where. It went to Exeter street near Huntington Ave. and the railroad tracks on land leased from the Boston and Albany...not a very pleasant place and a third of a mile from the academic buildings.

Walker's new edifice was started without enough money to complete it, but it was finished in 1886. About the same size as the Rogers building, it "was externally no architectural gem and contrasted most strikingly with the beautiful classic building with which it shared the grounds." (18, p 132)

The Walker building was at least functional, however, and its location allowed academic activities to continue in a compact, centralized area.

When it came to finding room for the Mechanics lab, displaced by the Walker building, another siting problem arose. Lack of capital and the immediacy of the problem prevailed, and the lab was put in a two story structure on Garrison St.--a half mile through the crowded city from the main complex, but convenient to a railroad line for transporting heavy equipment. The women's department was transferred to the Walker building.

By the fall of 1888, enrollment was almost triple (827) that of seven years before. Again the Institute was unprepared and overcrowded. During 1888 it purchased 19,000 square feet on Trinity Place for $76,000, a healthy price in those days, and erected a six story structure named Engineering A. Mechanical engineering got the two bottom floors, the next two went to drafting and classrooms, and civil engineering had the top stories. At the time M.E. and C.E. were the most expanding fields and the ones in which instruction required the most space.

"For the first time in many years," Prescott says, "the several departments of the school had breathing space, but even now, none had really enough to provide the best conditions for teaching or study, and research space was practically non-existent." (18, p 136)

This relatively happy state did not last long. Electrical engineering, physics, and chemistry were bursting out of their headquarters, and architecture...which operated pretty much as a separate entity...seemed the logical choice to be moved elsewhere. It too was growing, and in 1892, a small building later called Engineering B was built for architecture next to Engineering A.

Enrollment continued to increase, and the Walker administration was not putting on any artificial controls to keep it down. In 1893 the President saw a chance to consolidate future development around Trinity Place, and so Tech bought the rest of the square block to Stanhope Street and the railroad yards--50,000 square feet for $299,000, almost $1 more per square foot than the price for the first Trinity place land. A boiler house connected to Engineering A was the first structure on this site.

Again Walker began to build classroom facilities without the funds to guarantee completion. He obviously felt the money would have to come, and there was no sense delaying while overcrowding took its toll. Come it did, $750,000 from Henry L. Pierce, and the building was completed in 1898 after Walker's death. It added 25% to existing classroom space and housed architecture, biology, geology, and the Laboratory for Industrial chemistry. Engineering courses took over Engineering B. Enrollment was now 1,200, a 50% increase in 10 years.

Around this time a notable concern for providing non-academic facilities developed. In 1902 the Lowell Institute vacated the top floor of the Mechanics Lab on Garrison St., and the space was turned over to a Student Union. While not too far from the South End boarding houses where many students lived, the union was remote from both the main academic buildings and the gymnasium.

The Institute was in no position to erect dormitories, but in the face of a demand for student housing "a group of individuals consistituting the Technology Chambers trust, put up one hall on Huntington Ave. in 1902 that was supervised unofficially by the Institute. This was designed by Walter H. Kilham '89 for 178 students, but Technology Chambers housed a very small proportion of undergraduates." (22, Part I, p 6)

New advances in electrical engineering at the turn of the century made MIT want to be in the forefront of research activity and in 1902 the Lowell Electrical Engineering Lab was built on the Trinity Place site. It was the largest single structure at the Institute.

Growth needs continued to arise. In 1900 a department of naval architecture was added, and Physical Chemistry required more space...so a temporary 2 1/2 story structure, Engineering C, was erected on Trinity Place in 1903.

Two years later the lease on the Exeter St. land expired and the gymnasium was moved to a better location, next to the Student Union on Garrison St. With no open space in the center of Boston, the Institute had meanwhile purchased a playing field several miles away in Brookline.

The last major building project during the Boston period was a student center, erected in 1907 between Pierce and

Engineering C. Agitation for such a center had begun in the Technology Review several years before, but development lagged. The union on Garrison St. was thoroughly inadequate. When it did come, the student center was small (60' by 60' and two stories high), but it did provide a dining room, lunch counter, library, etc., close to the working classrooms and labs.

SUMMARY ANALYSIS

When the Institute was ready to leave Boston 10 years later, it was leaving behind extensive, but overcrowded facilities. One cannot talk of a "system of priorities" during the Boston period. Here was a pioneer, feeling its way, financially insecure and bound to establish a reputation for excellent technical instruction before it could think of research, recreation, student centers or dormitories. "Comprehensive planning" was something that could come only after the rawness of youth was passed.

It had been impossible to predict the lightning growth that occurred, and meanwhile a city had grown around the embryonic technical college, hindering coordinated, centralized development which the administrations had neither the funds nor the prescience to guarantee. New needs came swiftly, existing facilities were outgrown again and again, and problems were so acute that sometimes new buildings had to be started with absolutely no surety that they could be finished. Luckily, a sizable piece of land had been purchased in addition to the original site, but the six structures

located upon it were jammed together, with no open space between for relief or expansion.

Towards the end of the Boston period, research funds began to come through, and we witnessed construction of some special research facilities.

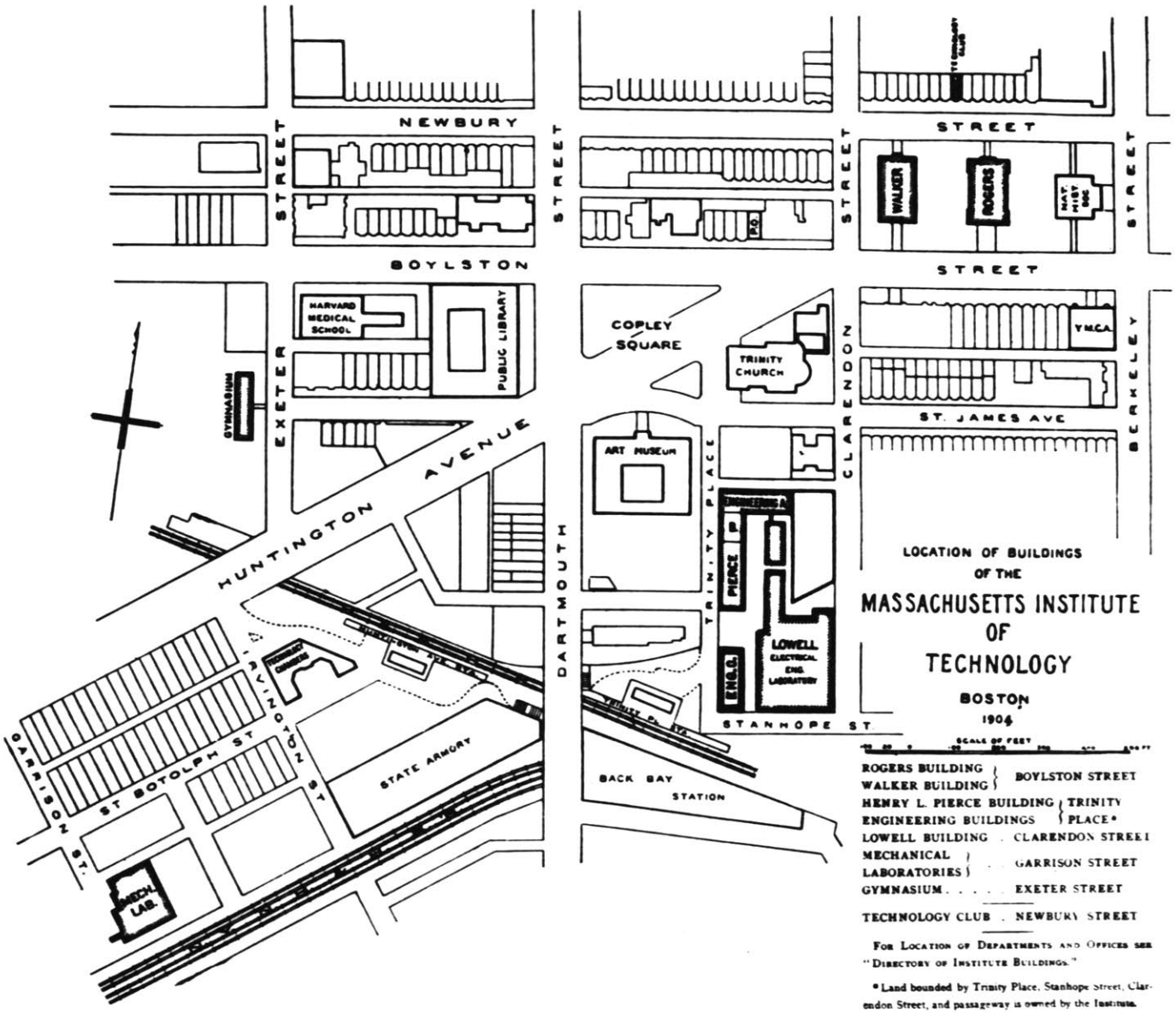
Although non-academic space was barely considered before 1900, Professor Bush-Brown points out that the situation was not so bad as it seemed. Boston's cultural center grew up around the Institute, and access to its great opportunities was even easier than it is today. The Library, the Museum of Fine Arts, theatres, and churches were all concentrated in the Copley Square area. The Institute did not provide them, but they were nearby to be used if the students wished.

Relocation

Moving the Institute from Boston to Cambridge was hardly a sudden decision. To the contrary, it took seven years of careful deliberation before making the decision to leave and seven years more before the Institute actually moved.

The first article suggesting a new location appeared in the "Technology Review" during 1902...Funds were arriving for a memorial to General Walker, but it was obvious to that writer that the Boylston St. area was unsuitable for any more permanent structures.

Map 1 - -M.I.T. in 1904



Meanwhile Harvard and Tech began to talk of merging for the nth occasion--something every President from Rogers on had fought against but this time a plan developed that seemed agreeable to both institutions and guaranteed the Institute's independence. Under the proposal, Tech would relocate on the spot across the River from Harvard now occupied by the Business School. Andrew Carnegie and Henry L. Higginson bought the land in preparation for the move, which never materialized because the merger plan fell through.

"By 1909 it was generally agreed that removal was the only real solution to the space problems. The vital questions were what location to choose and how to pay for it. The amount of land needed to make reasonable allowance for future growth was variously estimated at from twenty to sixty acres, and it was hoped that the new land and the buildings, in part at least, would be financed by the sale of the six acres the Institute owned in the Copley Square area. It soon became clear, however, that legal restrictions on the original grant of land would make removal very difficult unless it could be financed with new money." (18, p 248)

"As early as 1902 the whole Boston area had been carefully examined, several unoccupied tracts of land had been proposed as possible sites for the Institute, and some of them had been carefully considered. The so-called Fenway land at the corner of Longwood Avenue and Avenue Louis Pasteur opposite the property of the Harvard Medical School, not far from Simmons College, the new Art Museum and other educational institutions, was not very accessible and probably too small. Another site near Jamaica Pond between the Jamaicaway and South Huntington Avenue, half a mile from the land the Institute had already acquired in Brookline for an atheletic field, was too remote; and still farther away was a site in Hyde Park near Clarendon Hills. Another proposal was to make a new island in the Charles River halfway across the present Harvard Bridge...This suggestion was quickly discarded as impractical." (18, pp 248-9)

President MacLaurin originally thought 25 acres (four times as much as the Boston land) would be sufficient, but Coleman Dupont, who gave the largest gift towards the new site, prevailed on him for more.

"He asked what sites were under consideration and wanted a brief description of each. The first one I mentioned was 25 acres in area. He said 'Can you double it?', and I said 'Not this particular site'. 'Well', he said, 'I don't like the look of 25 acres. It seems to me too small. Almost invariably when a man comes to me to approve plans of a new factory...I tell him to double the size of everything and almost invariably I wish afterward that I had used a larger factor of safety. Technology will occupy a great position in the future and must have room to grow. I don't feel much attracted by 25 acres, but I should be interested in 50!"
(1920 Pres. Rept., pp 11, 12)

Of course Dupont's optimism was justified, but even he could not have predicted that the Institute would outgrow one 50 acre site within 20 years, and additional 50 acres in another twenty...

The original tract east of Mass. Ave. was purchased for $775,000 of alumni gifts, and construction got under way with an anonymous contribution of $2,500,000 by George Eastman. But before the actual move could take place, the Institute had set up a school of public health in cooperation with Harvard and a department of aeronautical engineering, making the Boston space situation even worse.

---- ---- ----

Relocation took time, but it was accomplished with foresight and it utilized the lessons learned during the first 20 years in Boston. Its object was to provide both academic and non-academic facilities, to centralize them---in a flexible way on a site that would allow sizable expansion.

"When plans for moving were first made, the whole scheme contemplated the purchase of a site, the erection of buildings containing lecture rooms and laboratories, the provision of a power house and its appurtenances, the erection of dormitories, of a center for student activities and a gymnasium (Walker), the provision of lunch and dining rooms, an athletic field, and the laying out of the grounds around the field and buildings."
(1916 Pres. Rept., p 17)

"As for flexibility within the academic buildings themselves, the engineer "recommended that the walls between units should not be designed to support above, but made removable so that future space changes could be easily made to meet the changing needs of the various departments." (18, p 265)

"The first group of buildings was finished in 1916 and was planned for 2,000 students---but MIT wisely adopted a policy of providing for expansion adequate for twice that number by additions to this central core that would preserve the unity of its architectural design." (22, Part I, p 5)

The first Cambridge period....1916-1938 (See Map II)

Academic buildings finished in 1916 were Numbers 1, 2, 3, 4, 8, and 10 on the main lot, Building 43 on the north side of Vassar St. and Buildings 45 and 43 used for power plant and maintenance equipment also on Vassar St., a total of 780,704 square feet of floor space.

The "Faculty" Houses were finished for dormitories, housing 200 men---64,500 square feet of floor space or 320 square feet per man. Small, personal living units seemed more desirable than one large dormitory, and control of the system was up to student government. Students from all four college years lived in these houses, with sections set aside for two fraternities...But accomodations were sufficient for only 10% of the enrollment. MIT was still not ready to house a substantial percentage of its student body.

The site had limitations which present difficulties even today. It was filled land with no solid base, and any structure had to be shored up on deep piles which added greatly to expense.

While the view of Boston was magnificent, the ground itself was completely flat and unrelieved by topographical change. In its early years the site looked something like a desert, with no landscaping to speak of until 1928, but it did possess the great advantages of plenty of open space and plenty of light and air between buildings.

"The new buildings were designed to accomodate all the educational activities which ranged through the fields of engineering, science, and naval architecture, with the exception of architecture which remained in the Rogers building in Boston until a later date. The circular room under the dome, originally intended as an auditorium, with appropriate monumental staircase, was used as a library with a narrow inconspicuous flight of stairs. Lecture halls, classrooms, drafting rooms, laboratories, shops and several specialized libraries were arranged throughout the new buildings in a logical plan according to the use and type of equipment."
(22, Part I, p 5)

As Miss Shillaber points out, the desired centralization did not materialize. The architectural school stayed in Boston for many years after the Institute moved. Legal difficulties were involved in disposing of the Rogers building, and the Administration soon discovered that not even the new complex was sufficient for the needs of all departments. Architecture, still not too integrated with other fields, was the most expendable.

During wartime enrollment decreased, but in 1920 the Institute once again found itself unable to accomodate a sudden unexpected growth in the student body, now 3,100. Many classes had to be held twice, and others met in laboratory space.

Building activity continued, but on a small scale...the Spectroscopy Lab, Buildings 30 and 46. The first major addition to the academic plant was the Pratt School of Naval Architecture (Building 5) finished in 1922 with 50,672 square

feet of floor space.

Purchase of the Boat House in 1922 was the first step towards a suitable athletic plant. Squash courts came three years later, but no major athletic building was added--despite frequent statements of need--until 1935.

At last the class of 1893 made a gift to provide more dormitory space and the first "Alumni" House, Bemis, was completed in 1924, adding but 96 places to the 200. To illustrate the serious nature of the problem, the special fraternity sections in the Faculty Houses were eliminated and turned over to non-affiliated undergraduates.

"Perhaps the most important and urgent step that could be taken towards the promotion of student welfare," said President Stratton in 1925, "is the construction of several new dormitories with a capacity of 80-100 students each." (1925 Pres. Rept., p 34)

Five departments had grown too large for their quarters by 1923, physics, chemistry, biology, electrical and mechanical engineering. More all-purpose laboratories were needed and the new emphasis on graduate instruction (See table A1) required specialized, smaller work rooms. Research demands intensified causing the President to say:

"It is hoped that in the near future additional laboratory space of simple construction can be provided for some of the heavier work in the various departments which should not be in the academic buildings." (1923 Pres. Rept., p 15)

In 1925 the report stated some additional pressing needs--an auditorium, a building for the architectural school, and development of the northern part of the site.

More dormitories, a decent gym, and an auditorium became perennial requests, and the lack of laboratory space was so

acute that some departments took to erecting temporary shelters on the grounds. "Simple, fireproof laboratory space," said the President, ".....would further do away with the many unsightly and unsafe temporary buildings now used for some of the work. (1926 Pres. Rept., p 43)

In 1927 some of these problems got relief. Four new units of Alumni Houses were completed and they brought the total accomodations on campus up to 430, or 1/7th of the student body (Enrollment had dropped back again to a more normal 2,800.). A 12-man Corporation Committee met and urged that the Institute should plan on housing 800 men (about 1/4th of the student body) "to provide a maximum of necessary comforts and livability without luxury." (1927 Pres. Rept., p 58) No mention yet of a residential college.

Aeronautical engineering had become a regular course two years before, and a course which required a large amount of heavy, noise-producing equipment. Since American businessmen were much interested in airplane development, response to the demand for AE facilities was large and immediate. The Guggenheim Laboratory--41,396 square feet--was begun in 1927, and became the first major laboratory devoted to a special instructional and research use to locate outside the main complex. Miss Shillaber says, however:

"The Architect Carlson placed the building north of those on Massachusetts Avenue and in direct line with them so that it could eventually be connected by an intervening structure." (22, Part I, p 8)

In 1926 MIT also finished the Homberg Infirmary (Building 11), bringing immediate and convenient medical attention right to the main center of activity and affording an excellent example of such integration to other institutions.

Two years later the northern part of East Campus had a second specialized lab building, building 31 for aeronautic and automotive engineering, and the last three Alumni Houses were ready for occupancy--making a total dormitory capacity of 620, far below that requested by the Corporation Committee.

Physics and chemistry still had unrelieved growing pains and much temporary laboratory space. Graduate research, said the President in 1930, was sorely hampered.

In his original statement of purpose, Rogers proposed establishing a Museum of Science and Industry as one of MIT's major elements. Small musea were incorporated with various departments from time to time, but the Institute never established a single, large museum illustrating great scientific developments. President Stratton felt such an endeavour would be both an achievement for MIT and a public service to the Boston area. He first asked for support in 1930, and again in 1931, but none materialized.

In 1931 physics and chemistry could finally doff their strait-jacket. Building 6--the Eastman Laboratories--was now completed, giving these fields 85,917 square feet of floor space and plenty of room for their needs. But some departments still had troubles. Architecture remained in Boston. Electrical engineering, business and engineering administration, biology and public health were terribly crowded. Once again the President called for a hydrodynamics laboratory and a towing tank for Naval Architecture (something first requested in 1895).

The Library under the dome of Building 10 was considered far too small.

But this was the depression period, and all construction activity stopped. To relieve some of the congestion, the Administration conducted its first extensive space survey and reallocation. One hundred different changes were made during 1932 alone...to some extent an indication of the built-in flexibility provided by the architects.

An enrollment drop came along with the depression, and 1933's registration was 500 less than that in 1931. (Graduate enrollment stayed steady, so the major decrease was in undergraduates). Seventy-four vacancies appeared in the dormitories, where once had been a long waiting list, and the dormitory system began to take severe losses.

The Administration responded by turning Crafts-Nichols-Holman into a graduate house for 78 men. While this action appeared more a reaction to financial loss than a pure desire to create accomodations for advanced students, it proved highly successful.

"So far as we know", President Compton said, "This is the first arrangement of this type in any technological school and one of the first in any educational institution."
(1933 Pres. Rept., p 26)

(Princeton built the first graduate center in 1915). MIT had the additional distinction of being the first university to put graduate housing close to undergraduate dormitories so that the two groups could have some contact with each other.

In the next year, Runkle, Atkinson, and Ware were added

to the graduate house, giving it 206 out of 625 places. For two years this proved to be a happy arrangement, and there was no talk of increasing dormitory space. But by 1936 the New Deal had put the American economy in a happier frame of mind and this new optimism was reflected at MIT in another sharp enrollment increase. Again the dorms proved inadequate. There was a waiting list of 123 for the Graduate House and 200 for undergraduate rooms. President Compton called for new building to house 200 undergraduates, but at the same time he articulated a policy in regard to waiting lists which the Institute has followed ever since.

"There is undoubted advantage of having a waiting list. This enhances the value of the dormitories in the eyes of the student body and strengthens the hands of those students and administrative officers who have responsibility for administering discipline in the dormitories." (1936 Pres.Rept., p 25)

Once again, he pleaded for a gymnasium.

"Among the many colleges and universities large and small, of my own acquaintance, I cannot recall any other which approaches this institution in the unattractiveness and inadequacy of its gymnasium." (1936 Pres. Rept., p 26)

Some other needs expressed during the year were for a wind tunnel, a high voltage laboratory, a new biology laboratory, and again the towing tank.

In a few months, two of these--the wind tunnel (Building 17) and the high voltage lab (Building 46) were under way.... the first adding to the development north of the main complex, and the second going on Vassar Street. Over 375 dormitory applicants were refused in 1937, more than half the actual number of beds. 1937 also marked the beginnings of a home for architecture in Cambridge and a main entrance for the Institute on Mass. Ave. (Building 7, the new Rogers Building).

Another reallocation study made 80 space changes and converted a number of large unusued classrooms into lecture halls.

Athletic facilities were not completely neglected, but they remained on the bottom of the priority list. In 1935 the small (7,620 square foot) Barbour field House was constructed next to the running track on East Campus, and in 1937--anticipating a gymnasium for the Western side of Mass. Ave.--the President suggested moving the track across the Ave. and converting the Walker gym into a 400 person theatre. Neither the gymnasium nor the theatre materialized, and the track stayed for three years longer.

"The dormitory situation," said President Compton in 1939, "is now satisfactory." At last another living unit had been set up, a new Graduate House for 371 men. The Institute purchased and converted the hotel on the corner of Mass. Ave. and Memorial Drive, and the Faculty Houses became a senior dorm in an attempt to inculcate some class spirit and loyalty before men graduated. This experiment harbinged future attempts at creating a special undergraduate living environment.*

Although the new Graduate House had a waiting list of 61, Dr. Compton did not feel any further building would be necessary..."with the possible exception that we may wish to arrange for married graduate students and junior staff members, though probably not as a dormitory operated by the

* The 48-apartment Bexley Hall on Mass. Ave. was also acquired in 1939 and used largely by younger faculty members and staff.

Institute." (1938 Pres. Rept., p 16)

SUMMARY ANALYSIS

Establishment of the Graduate House marks the end of what we can call the first of three stages in the Institute's Cambridge development. Succeeding stages were to change markedly the nature of the site's arrangement and the character of the environment. It would be well to pause here and analyze the site as it looked in 1939.

Every bit of building space had continuous, intensive use, yet the space was efficiently arranged; activities which needed to be integrated with each other were integrated; and the site was differentiated into four separate, internally consistent areas of land use.

1. The main complex: Here the major academic departments, research and classroom facilities were concentrated in one structure which--though perhaps too large and "Pentagonish" for a pleasing aesthetic impression--allowed constant, easy inter-communication. The original structure had been filled out and balanced with additions over twenty-three years. Students could walk from class to class, to lab, to library in a minimum of time without leaving the building. When one department grew or another contracted, the flexible interior construction could be readjusted with a minimum of effort and cost. One section in a central position (Building 3) was devoted to administrative offices and another (Building 11) to medical facilities, enabling these highly important functions

to be located within the area of greatest population movement. It is unfortunate, though, that the long corridors and the two interior courts should have become barren, lifeless space. While the latter allowed light and air to penetrate every room, they were and are unlandscaped and depressing. With all these facilities interconnected, both the initial cost and upkeep of the utility lines were substantially reduced.

2. The specialized complex: Some departments required heavy noise-producing machinery for research and instruction which would be noxious and disruptive if located within the main building. For a while funds for separate structures were unavailable, and this machinery did have an unhappy effect, but eventually the north end of East Campus and Vassar St. developed into a specialized complex of single structures. Activities like aeronautical engineering, wind tunnel operation, and the like usually did not depend on close integration with other departments,so they could be put into separate buildings. The chemical engineering building (38) and the Hydraulics Laboratory (21) did use personnel from the main complex, but this research was highly specialized and could be isolated with little trouble. Buildings and Power's service facilities were also set in this section. Aesthetically, this low group provided a pleasing contrast with the main building.

3. The athletic complex. Admittedly it was inadequate, yet what did exist made student participation easy because it was a 'stone's throw' from both the dormitories and the academic plant. Except for the Coop field on West Campus, it too

was centralized. Another advantage of the main athletic field lay in its value as a buffer zone between dormitories and academic plant. Neither encroached upon the other. They had this pleasant and functional open space in between as well as the green which was later to be used for Hayden Library.

4. The living-recreation complex. Until 1938 all resident students were concentrated on the eastern end of the campus with the President's house, the dining and recreation facilities of Walker membrial, and the tennis courts nearby. Men who lived on Campus could move from activity to activity with a minimum of time and effort. With establishment of the Graduate House in 1938 the centralization of student living quarters was ended (although many men had had private suites in the hotel before) and development of West Campus began.

Parking space was sufficient and convenient to all buildings.

While plenty of room for expansion existed on the East Campus property, the surrounding area was already highly industrialized and congested. Factories, many of them noisome, formed a backdrop to the Institute.

Priority All types of facilities required by a university were considered important yet dormitory and recreation buildings lagged far behind academic plant construction throughout

the period. Despite the set back of the depression, MIT really never stopped growing, and Dr.Compton was forced to set a limit of about 600 on freshman classes beginning with 1937. Classrooms and laboratories suffered tremendous strains, and new research needs continually arose. Since MIT's reputation and financial backing had become secure, the major academic needs--except perhaps the hydrodynamics lab, towing tank, and biology lab--were responded to within a relatively short time after they appeared, although the demand was never completely satisfied.

While administrations now considered dormitories important, they had developed no conception of a need for any particular brand of student life to operate within a dormitory system. Except for the original dorms tied in with Walker, all living unit acquisition came long after it was requested. Here too the demand was much greater than the supply.

Walker soon proved too small and inadequate for the volume of student activity that was developing, yet repeated pleas for an auditorium and a real gymnasium went unanswered. Actually the cultural and religious situation was more acute than when the Institute operated in Boston, because the Cambridge site lacked proximity to museums, public library, and churches. There was no chapel, exhibition gallery, or theatre at MIT in 1939, and the requests for a museum of science went unanswered.

At the end of the first Cambridge period, the Institute was well established in a smoothly running plant, yet new needs were felt constantly and the non-academic side had not

yet come into its own.

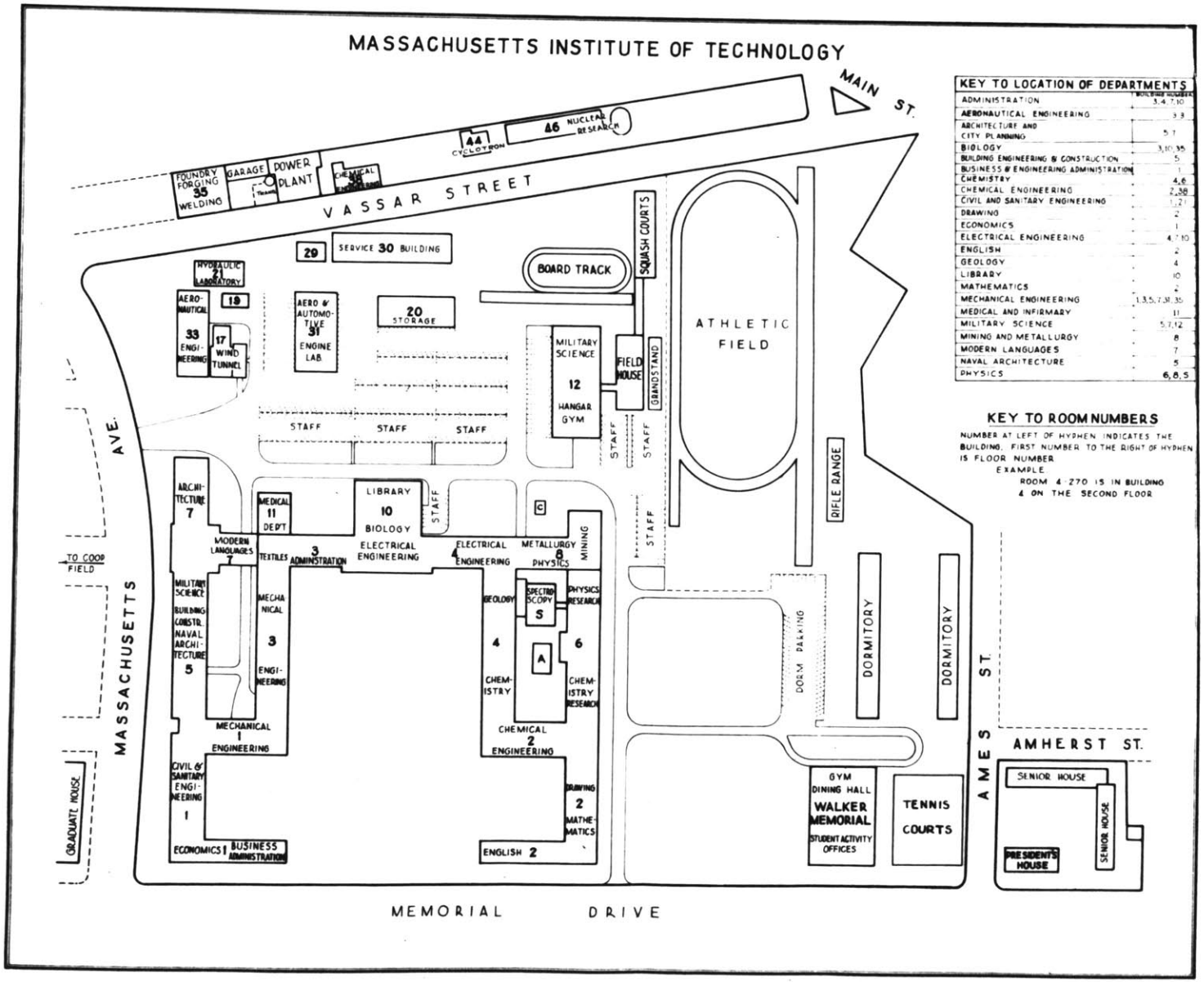
The Second Cambridge Period 1939-45

Two major currents run through this brief but significant six-year period--transition and unharnessed growth. The phibosophy of the "whole scientist" that was later to make sweeping changes in MIT's educational objectives appeared in embryonic form, brought the beginnings of a new emphasis in physical development, and built up support even while the war was curtailing all but essential construction. War itself took control of physical development largely out of MIT's hands. While the Institute declined to undertake defense research which could not be conducted equally well elsewhere, military projects received almost undivided attention, created severe space needs, and resulted in the construction of several "temporary" buildings which remained in use after the emergency had ended.

"While no major addition to our educational buildings had been made since the occupation of the magnificient William Barton Rogers building a year ago, we have completed or begun three small structures important to our research program, opened a notable new museum in the Rogers building, provided new quarters for our women students, dedicated a new field house and athletic field and begun construction on the first unit of our projected athletic center." (1939 Pres. Rept. p 16)

The three small structures filled out the "specialized" complex---the cyclotron on Vassar St. built in "record time" for the manufacture of radioactive chemicals used in medical and biological research; the three-million volt generator designed for ultimate use in cancer therapy (Building 28); and

Map 2---- M.I.T. in 1939



a solar energy lab.

The museum was not Stratton's monument to science and industry, but the Dard Hunter Paper Collection, a significant and unexpected addition which remained until the late 1940's.

For its growing number of women students, the Administration provided a new Margaret Cheney Room in Building 3, with a lounge, study, kitchen and locker room. At that time no special women's dormitory existed.

Perhaps the most significant activity of 1939 was the Alumni Fund's campaign for a swimming pool on East Campus that netted $429,000 and signified that body-building would no longer be relegated to the bottom of the priority list.

Along with a new track and field on West Campus (the East Campus field was eliminated) went the Briggs field house, containing showers, rubbing room, dressing room and lockers for 450. This was to be just a beginning.

"The building is so constructed that it will be possible eventually to construct beside it a cage, which is one of the desirable units left to the future." (1939 Pres. Rept., p 18)

"Through these various improvements, embellishments, and additions, we have made progress in providing facilities to 'build the man as well as the mind' to use the slogan of the Alumni Fund Campaign." (1939 Pres. Rept., p 19)

Policy and programs were changing, but war loomed closer. While the President felt his educational program was undergoing a thorough overhaul and that the non-academic side of student life was improving, he believed "that the major emphasis now needs to be laid on strengthening our abilities to perform important scientific and technical services of

high calibre or unusual character to government and industrial agencies."..i.e., more research. In line with this recommendation, a visiting committee called for increased enrollment in chemical engineering and a conveniently located new building for heavy equipment. Another committee urged a larger quota for aeronautical engineering. Demands for automotive engineers grew too, and the lack of drafting space in these three fields was "an absolute bottleneck". Plans for new lab facilities were drafted and waiting for support.

Within a year support was forthcoming. Alfred P. Sloan gave $100,000, and the internal combusion laboratory was expanded by 11,372 square feet. In addition the obsolete wind tunnel in Building 17 was dismantled, making room for a second floor and new drafting space, lecture rooms, research rooms, laboratories, a graduate student's lounge, and a more compact wind tunnel to boot. Enrollment in aeronautical engineering increased 30%.

A $200,000 Rockefeller grant enabled the long delayed enlargement of biological engineering to take place. Food technology became centralized in the old Building 35 and the biological engineering labs consolidated in the main complex, but by all rights these two activities needed association in the same building.

Developments in biological science meant severe curtailment of other departments' growth, notably physics and chemical engineering, and the "..intensive utilization of every square foot of space to be found in our educational plant." (1940 Pres.Rept., p 20)

It was about this time that the library problem also became acute. The area under the dome could not hold all the necessary materials, and several departments maintained separate facilities. In 1940, Walker Memorial's library was enlarged to house all of the English and History collections, which further intensified the scattering. Within a few months a visiting committee began to study plans for a library building which would centralize the Institute's collections.

---- ---- ----

Even before the outbreak of war, MIT went on a crash defense program, and 135,000 square feet of floor space or 10% of the academic plant was devoted to government research by 1941. Building 32 was built to expand the program, a temporary floor was added to the Eastman Lab, and Buildings 12 and 24, originally scheduled for chemical engineering, were raised in record time to add almost another 100,000 square feet to the defense effort.

"Even with all these buildings available we continue to have such a high degree of congestion in all our buildings, old and new, that we have for some time refused to undertake additional defense research projects unless they are of the first priority and unless no other arrangements for their prosecution appears feasible and comparably favorable for successful and rapid prosecution of the work."
(1941 Pres. Rept., p 12)

Still and all the Institute was at the Government's call, by 1942 over 435,000 square feet had been added and devoted to the war effort along with 73,000 square feet of the pre-war buildings.

Concern for the student outside the classroom continued to develop despite this concentration on other matters. A committee on Student Life was appointed for the first time in 1941, and it recommended changes in the dormitory system so "resident students may live under conditions most conducive to their cultural and social growth."(1941 Pres.Rept., p 29) In response to their report, President Compton suggested constructing dorm facilities for another 100 men.

---- ---- ----

As the conflict drew to a close the Institute was ready with a whole set of building plans. With real insight, it expected a high proportion of married students among the returning veterans and wanted to provide housing for them on West Campus. It was also committed to creating a new library, and it decided to house some women students in a Bay State Rd. house purchased by the Alumnae. Army and Navy research was expected to continue, and segregation in separate structures away from academic activity was felt essential.

SUMMARY ANALYSIS

The war years had seen a real awakening of interest in student life, the beginning of plans for extensive housing and recreation facilities, and actual development of an athletic plant which shifted some of the focus of activity from East to West Campus.

All-out participation in the war effort had left the Institute with almost half a million square feet more floor space than in 1939, much of it in temporary structures scheduled for early demolition. Not only had additions been made to some facilities (Buildings 6, 31, 32, 46, 30) but great wens of wooden barracks threatened to blight the North end of East Campus. While the specialized complex remained one of individual buildings erected for specific purposes, it was now congested with facilities often put up too quickly to consider the most efficient use of space or allow for future expansion.

The athletic plant was divided in two; with field facilities on the West and the swimming pool, rifle range, and squash courts still on East Campus, and now that the athletic field had been shifted, the specialized complex and parking lots spilled over towards the East. The dormitories--anticipating construction of Hayden Library--no longer had the buffer strip of green between themselves and the academic plant. With the conversion of Buildings 24 and 12 to peacetime uses, the regular academic and administrative activities began to encroach upon the specialized complex.

In six years the clear differentiation between the four areas of land use had largely disappeared. Still, activities were centralized. Buildings 12 and 24 were connected up with the main complex, and most teaching and research was carried out on East Campus. A new role in government research had caused MIT to adopt a policy of segregating this activity

from peacetime education and research, and so the Hood, Whittemore, and later the Barta Building--additions to the specialized complex extending beyond Albany St.--became foci for classified investigation.

The third Cambridge period 1946 to the present

This may be called MIT's humanistic period, because the type of planning and construction emphasized has been almost diametrically opposed to previous policies. Building for academic and research needs continues on a large scale, but the chief goal has been to provide for recreation and living, in line with re-evaluation of objectives. This has also been a period of lateral expansion to both west and east, of further segregation of government projects, and of realization that the Cambridge site offers immense difficulties if growth is to continue.

- - -

Unfortunately President Compton's goal of eliminating all the temporary wartime structures did not materialize. Government work continued on a large scale; a gigantic enrollment increase required more space than pre-war classes; and the Institute had to spend $1,750,000 to readapt its facilities for peacetime use.

Some of the barracks space became a 600 man dormitory. Other units housed more than they were designed for, Westgate and later Westgate West went into operation for a total of 290 married students, and initial plans were readied for a

large new dormitory. Twenty-nine hundred men (compared with about 1,000 before the war) were housed on campus in dorms, Westgate, and the three fraternities on Memorial Drive. Academic facilities had to be refurbished for the new population; and the freshman and sophomore chemistry labs were expanded to accomodate 900 men each, compared with 600 in 1940. Other expansions were made in physics, mechanical, electrical and aeronautical engineering, and a gas turbine laboratory was inaugurated.

If need for a gymnasium was pressing in the Thirties, it was doubly so now, and the President asked for support once again. The hydrodynamics lab and the towing tank were still not built, and a new metals processing laboratory, a laboratory for nuclear science and engineering, and a building for biology and food technology were also considered essential.

But by far the most significant development in the years just after the war was final construction of the Hayden Library. It would become, the President said, a center for humanities and social science and for student's non-professional development.

> "This concept recognizes that the humanistic response of the Institute's library is in some ways even more far reaching than that of the libraries of great liberal arts institutions...(It) will house our departments in the social sciences and humanities so that they will be continguous to their libraries, which are in effect their laboratories."
> (1946 Pres. Rept., p 16)

In 1949 (the year of the Educational Survey) a new supersonic wind tunnel was completed on Amesbury St., a laboratory which required isolation from campus activities both because of its noise and its classified nature. This lab and the

small solar house erected on Memorial Drive three years before, were the first specialized facilities not to be located in the area North of the main complex.

Also in 1949 Building 58, an electrostatic generator for the laboratory of nuclear science and engineering was started on a pieee of land sandwiched between the rifle range and parking lot and the neighboring industrial buildings, and at last the hydro-dynamics lab and towing tank (Building 48) got under way on Vassar St.

In the same year Tech purchased the Hennesey block, giving the Institute all the Massachusetts Ave. frontage except for the Armory and the Coop.

Non-academic activities continued to undergo important developments. West Campus got another 400,000 square feet of playing space including new tennis courts and a baseball diamond. Rockwell cage was erected next to Briggs field house. Building 18--one of the wooden structures on East Campus--became a student activities center, and Baker House was readied for occupancy. The theory behind Baker and Burton, which followed it two years later, departed from the previous policy of providing small units for undergraduates. Baker housed 350 and Burton was to hold 600. With the purchase of the Riverside Apartments (Burton) the Administration hoped to have 2/3 of the student body housed on campus....a hope that never materialized.

In 1949, the Dean of Students listed what he termed immediate needs. Among them were: a new gym and crew house;

an auditorium and little theatre; more playing fields; a chapel; renovation of Walker, and a new all-purpose student union on West Campus which was now the center of dormitory life.

-- - --

While a private company constructed 100 Memorial Drive in 1948-49, it was built on Institute land, designed by MIT architects, and will one day revert to Institute ownership. The Administration hoped this would become a residence for faculty members, but the rents soon proved so expensive that most staff people could not afford them. A number of MIT people did move into the building, however, and it proved a start towards bringing staff living quarters closer to the Institute.

Academic building continued along with residential, and ground was finally broken for the Metals Processing Lab (Building 35) and the Dorrance Building (16) for biology and food technology, both completed in 1952. During no previous peacetime period had new buildings been added with such speed ....aided to a great extent by a $20,000,000 development fund campaign.

But space conditions remained so crowded that Buildings 20, 22, and 18, which should have been torn down long before, were still in operation. The first two housed mainly the Research Laboratory of Electronics and the Laboratory for Nuclear Science and Engineering, whose requirements were growing out of hand.

A new School of Industrial Management was created in 1951 to encourage a "cross fertilization between science, engineering, the social sciences and men thinking in terms of management." (1951 Pres. Rept., p 9) To house it the Institute expanded eastward along the Charles, buying Lever House as Building 52. A badly needed faculty club located on the top floor, and Dewey Library was brought over from Hayden. 1951 also marked the ultimate segregation of some defense activities, transfer of Project Lincoln outside the Institute to Bedford. 2 (Keyes D. Metcalf, librarian of Harvard, conducted a study at this time which led to the stabilization of the library system, with main headquarters in Hayden for the general s science and humanities collections and three divisional branches...Dewey, Rotch, and Engineering.)

--- --- ---

A thoroughgoing reallocation plan (the fourth) came as a result of the three new buildings (14, 16 and 35), and the Kresge gift made an auditorium and chapel finally realizable.

Integration of fraternities with the rest of the student body had been a problem of long standing. Only a few were able to settle on West Campus, and over 800 men lived in houses across the River. An ad hoc Corporation Committee met in 1951 to recommend leasing West Campus land to fraternities which might wish to build permanent residences. (The fraternities refused to consolidate in large Institute-subsidized dormitories.) Only five groups showed any interest, however, and the whole idea has since been tabled.

Housing was a continuing problem, and by 1954, 1/5 of the student body was married. Both graduates and undergraduates were asking for accomodations in Westgate and Westgate West, and it was now obvious that these "temporary" buildings could not be maintained much longer. The athletic plant was also too small for an enrollment that boded fair to increase still more.

"By building multi-storied housing for married students," the President said,"we can release land now inefficiently used and with the land so released, it will be possible for us to invite fraternities to build houses on the campus, to move our playing fields Westward and enlarge them and to provide urgently needed space nearer to the central part of the Institute." (1954 Pres. Rept., p 25)

The problems were there, but the policies not fixed, so the President appointed several committees to make recommendations which will be analyzed in the following chapter.

SUMMARY ANALYSIS

Between 1948 and 1955* new building raised the value of MIT's plant from $19.5 millions to $34 millions, and the Compton lab (which brought final demolition of Buildings 22 and 18) now under construction for nuclear science and the RLE will raise the figure still further. Postwar construction has focused chiefly on student housing and recreation facilities as a result of re-evaluating attitudes towards the place of student life in the Institute, but there has also been a significant growth in the academic plant.

The specialized complex is now almost obliterated as a

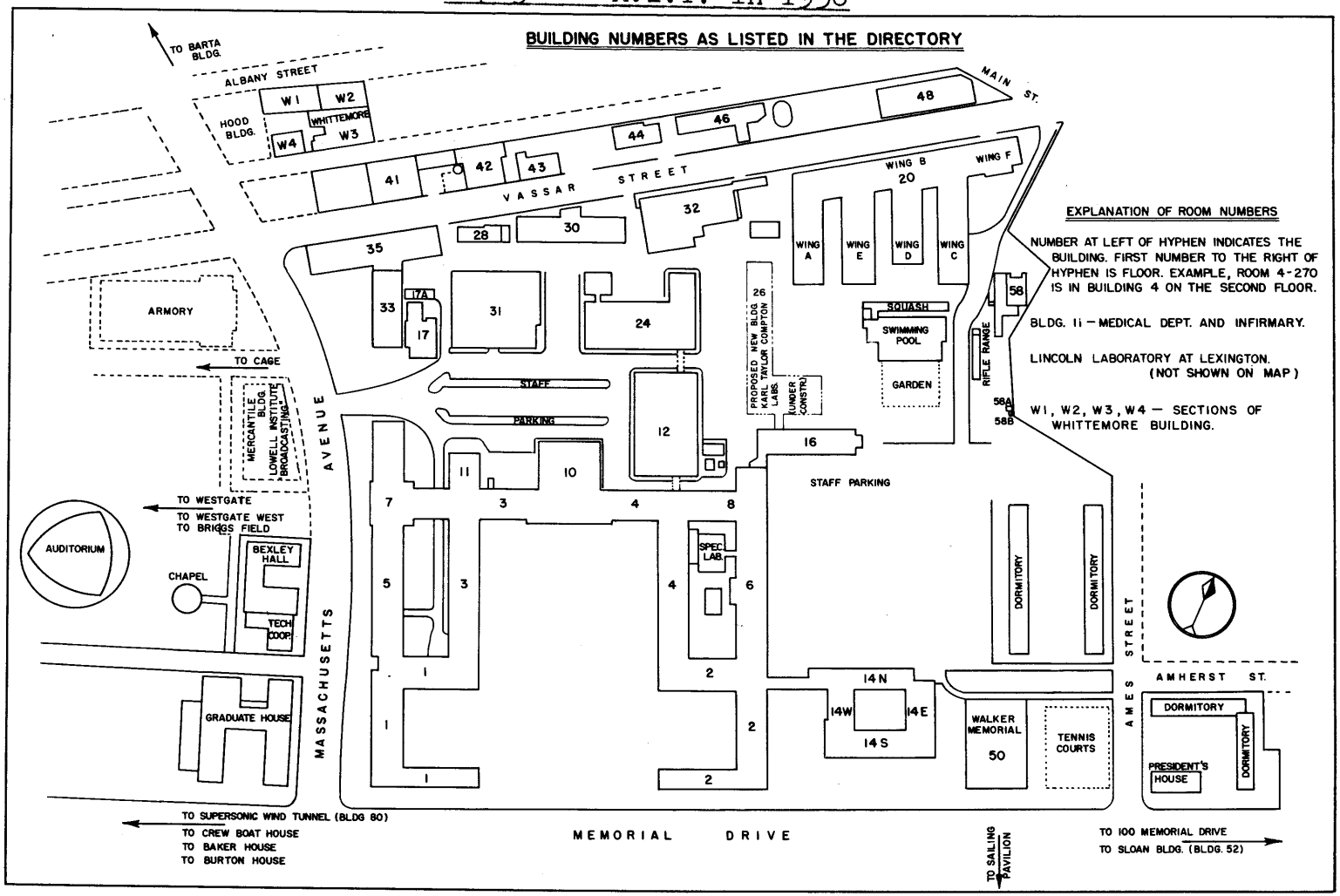
* The Kraft Building northwest of the main plant was acquired in 1955 for special research use.

separate entity. With the Dorrance Building and the Compton Lab, specialized facilities are being connected to the main complex, and, with the Metals Processing Lab adjoining the Guggenheim Building, they are being connected with each other. A new, centralized library is attached to the academic buildings. Segregation of defense activities continues, although some classified projects are located within the main academic complex.

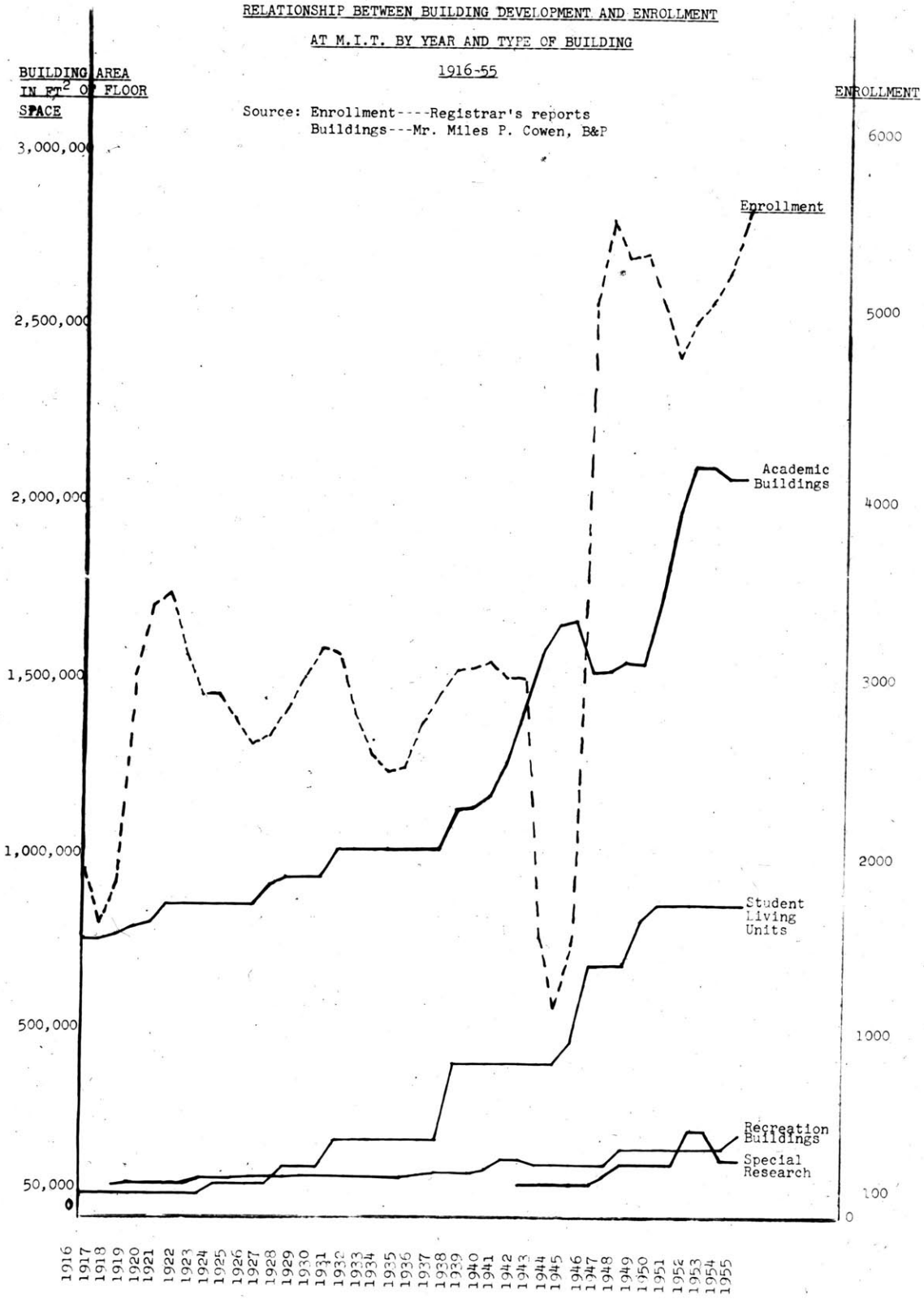
Complete centralization has proved impossible once again. Administrative offices have grown too numerous to be confined to one building and are scattered through 3, 7, 1, 10 and 24. Expanding to the east, the Institute now has a school of industrial management far afield from its other facilities. Instead of being the center of undergraduate life, the East Campus houses are essentially isolated from the main concentration of living units and are becoming more encroached upon by academic buildings. The athletic plant is divided in two. Parking lots have replaced green space with a vengeance, and each new structure brings more employees with cars, and eliminates more potential parking area.

There is no concluding note to this chapter. Chapter III follows logically from the preceding discussion and in Chapter III, we will make a detailed examination of the present-day MIT plant and its problems.

Map 3---M.I.T. in 1956



Graph 1


RELATIONSHIP BETWEEN BUILDING DEVELOPMENT AND ENROLLMENT
AT M.I.T. BY YEAR AND TYPE OF BUILDING
1916-55
Source: Enrollment----Registrar's reports
Buildings---Mr. Miles P. Cowen, B&P
BUILDING AREA IN FT² OF FLOOR SPACE
ENROLLMENT
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
50,000
0
6000
5000
4000
3000
2000
1000
100
0
Enrollment
Academic Buildings
Student Living Units
Recreation Buildings
Special Research
1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955

CHAPTER III

WHAT EXISTS --- FACILITIES AND ENVIRONMENT

Sooner or later a discussion of an organism's development must depart from the realm of generality and get down to an analysis of specific components. Before thinking about where we can go from here, it is necessary to know where we are.

This chapter will be largely statistical and descriptive, rather than analytic. Its purpose is to supply information about the facilities available to MIT and the nature of the environment around the Institute. Part 1 will deal with land and buildings. Part 2 will go into the characteristics of specific uses--classrooms, laboratories and offices, housing (and the residential location of staff and students), athletic plant, and parking. Part 3 will discuss the relationship of the Institute to the surrounding physical environment in Cambridge.

Part 1

The following tables show the amount of land area devoted to MIT's activities within Cambridge.

Table 1.

Total area East of Mass.Ave. (excluding Sloan Bldg.and land not bordering on Vassar St.)	=	2,040,000 ft^2	= 47.75 acres
Total area West of Mass.Ave. to Amesbury St.	=	2,480,000 ft^2	= 56.00 acres
		4,520,000 ft^2	=103.75 acres
Kraft Building site		45,227	
Sloan Building site	=	125,500 ft^2	
Barta Building site	=	14,833 ft^2	
Whittemore Building site	=	30,000 ft^2	(approx)
		215,560	= 3.98 acres

TOTAL LAND AREA = 4,735,560 ft^2 = 108.73 acres.

Table A3 is an inventory of each Institute building by type of use and size, and the following itemization represents a summary of the data.

Table 2

Type of use	1955 ft^2 total	Percent
Academic group (excluding Compton Lab)	2,034,706	60.3
Special and DIC	157,265	4.8
Service and Maintenance	42,398	1.3
Living	903,169	26.8
Athletic and Student Activity	224,476	6.8
Total:	3,362,014	100.0

The Compton Laboratory will add 135,000 ft^2 to the academic-DIC groups, giving them a total of 2,326,971 ft^2.

To give some indication of the great amount of building activity since the war, the writer prepared a comparison between the building areas and floor area ratio (av.) on East Campus in 1940 and in 1956 (including the Compton Lab). This data follows:

Land on East Campus (including Vassar St. but not the Sloan building) = 47.75 acres = 2,040,000 ft^2.

1940 building area total on East Campus = 1,464,225 ft^2.
FAR (av.) = .71

1956 building area total on East Campus = 2,378,975 ft^2.
FAR (av.) =1.14

Ft.^{2} area constructed since 1940 = 914,750.

Percent increase = 63%

---

* Not including DIC projects within the main plant.
Table compiled from Buildings and Power data.

(Note: This is only for East Campus. In 1940 all the Institute buildings provided 1,795,186 ft^2 and in 1956, 3,497,014 ft^2, a difference of 1,701,828 ft^2 or a 94% increase.)

A final breakdown will show the square foot building area in institutional use (i.e. academic or research) which is outside the East-Campus-Vassar St. area.

Table 3

Sloan Building	126,157
Barta	32,865
Whittemore	71,500
#80	32,200
Kraft	35,170
Solar Lab	800
	298,692 ft^2

Percent of institutional use outside main area = 13.6%

Part 2

A thorough analysis of internal facilities would attempt to trace in precise terms the location, number, type of use, area, and intensity of use of three categories of space consumption.....classrooms, laboratories, and offices. Unfortunately it was impossible to be this thorough for every category in the time available. Each will be treated in the following sections, but the classroom situation will be done in the greatest detail, and the writer hopes it may serve as a model for future investigation of other functions.

CLASSROOMS

Number and location: Table 4a gives the number and location of

the classrooms at the Institute. Map A1 shows how they are distributed from building to building across the site and gives the total capacities for the rooms in each building. (Note: There will be some minor discrepancies between Table 4a and Map A1. The latter was compiled from Registrar's Office figures for 1955-6, and the former was compiled from Schedules Office records made at a later date. As the following discussion will show, classrooms are frequently shifted around, so some discrepancies may be expected. Schedules Office figures were used, however, in all calculations except Map A1.)

These figures illustrate that the great majority of classrooms are concentrated in what we orignially termed the main academic complex, and that buildings 2,1,3, and 5 have the largest number.

Relatively few classrooms are in the "specialized complex" and in the buildings now joined to the main plant. This illustrates that activities in those structures are primarily research and laboratory oriented.

Intensity of use:

Tables 4a and b and Graph 2 indicate how intensively M.I.T.'s classroom facilities are used. The figures indicate that classroom facilities---far from being overtaxed--are more than sufficient to meet present needs. They are used at only 42.6 percent of their capacity for class purposes during the weekday hours, 9:00 a.m.--5:00 p.m. Once we eliminate rooms used only for sporadic special activities and rooms

remaining empty, the use factor for the rest climbs to only 45.6 percent.

Morning hours are much more popular than afternoon (49 percent or 52.6 percent compared with 37 percent and 38.7 percent).

Table 4a indicates that rooms in Buildings 2,4,6, and 12 get more than average use, but that a great amount of flexibility remains within other buildings.

Eleven classrooms in the main complex (1-10) are empty or devoted to special activities. The others are used only 50.6 percent of the time.

Graph 2 shows how intensely classrooms of different sizes are used and compares them with facilities at Harvard. Each category at M.I.T. is used less than its counterpart at Harvard. This may indicate: a. that M.I.T. is oversupplied with classrooms for its enrollment. b. the differing emphasis in each school.. laboratory work at M.I.T., lecture work at Harvard. c. both.

Medium-sized rooms (30-50 capac.) make up the bulk of the facilities and get the most use at M.I.T as well as at Harvard, while the smaller units (less than 30) and the larger ones (50-250) are utilized to a much lesser degree. M.I.T.'s only classroom over 250---10-250---caters to relatively few courses.

It is important to point out the implications of three factors which do not appear in these statistics...time consumed in setting up and breaking down apparatus, time devoted to special events, and conflicting schedules.

A. The larger classrooms....ie. 10-250 and 2-390 are used

primarily for introductory courses in the basic sciences which usually require complicated demonstration apparatus. Often as much as an hour is required to set up equipment before the lecture and an hour afterwards for dismantling. Taking this factor into consideration, the larger classrooms get more actual use than the figures indicate, and their assignment is not too flexible. (Note: another classroom about the size of 2-390 is going into the Compton Lab.)

B. A few of the rooms not employed for classes get rather constant use as meeting places for special activities such as conferences and placement interviews. The Schedules Office receives many calls for single events which it locates either in classrooms during off hours or in a few rooms reserved for this purpose. Now that Building 18 has been dismantled and the volume of student extra-curricular activity has increased, undergraduate organizations often take classroom space in late afternoon and evening.

Although there is a constant demand, the demand for special classroom use is always satisfied and is never great enough to put strain on the facilities and reduce their flexibility.

C. Staff and student scheduling problems are important considerations in assigning classroom space. Few professors wish to hold classes in the late afternoon or on Saturdays. There has to be sufficient leeway inside the plant to reschedule classes which conflict with key courses and still have rooms available.

Since all students in the first two undergraduate years take many of the same courses, it has been necessary to divide these groups into several sections or labs and hold some on Saturdays to avoid time conflicts. Although the number of Saturday sections is substantial (See Table 5), it is not large enough to put any inordinate pressure on the available facilities.

A final breakdown (Table 6) shows the number of lectures and sections by fields and special courses which meet in each building. Almost every subject is concentrated within one or two buildings, close to its departmental headquarters. Departments like electrical engineering (VI) and physics (VIII) whose enrollments are now at peak capacity, have been unable to carry out this general centralization, and their classes are scattered through several buildings. Since most of the scattering goes on within the main complex, it is of little disruptive significance.

It is also noticable that courses like english, humanities, and languages, whose departmental offices are in the library, carry on much of their class activity in Building 2...due partly to the lack of classroom space in Building 14 and partly to accommodate students who will be coming from or going to other classes in the main complex.

As general conclusions from these data, we can say that classroom activities are efficiently organized, and that the existing stodk of classrooms possesses fair amounts of flexibility and reserve capacity.

Table 4a

INTENSITY OF USE OF M.I.T. CLASSROOMS BY BUILDINGS

(9:00 a.m.-5:00 p.m.)
Monday-Friday

Building	A*	B*	C*	D*	E*	F*	G*	H*
1	19	760 (2)@	340	44.6	176	46.5	380	42.3
2	36	1440 (2)@	932	64.6	519	70.7	413	57.3
3	16	640 (3)	261	40.6	149	46.6	111	30.9
4	8	320	196	61.3	117	73.0	79	49.3
5	14	560 (2)	224	40.0	125	44.5	99	35.4
6	3	120 (1)	53	44.2	45	75.0	8	13.3
7	2	80 (1)	13	16.3	6	15.0	7	17.5
8	7	280	122	43.6	81	58.0	41	29.3
10	2	80	38	47.5	20	50.0	18	45.0
12	4	160	98	61.0	56	70.0	42	52.5
14	5	200	92	46.0	53	53.0	39	39.0
16	3	120 (1)	35	29.0	21	43.8	14	23.4
20	6	240 (2)	95	39.6	55	45.6	40	33.3
24	4	160	39	24.4	32	40.0	7	9.0
31	2	80 (2)	33	41.5	27	67.5	6	15.0
33	5	200	65	32.5	41	41.0	24	24.0
35	3	120	39	32.5	27	45.0	12	20.0
52	14	560	195	34.8	107	38.3	88	29.3
	153	6280 (16)	2870	45.6	1657	52.6	1213	38.7

*Key

A--Number of rooms used as classrooms
B--Total possible hours, 9:00 a.m.-5:00 p.m., Monday-Friday
C--Total hours used..... " " " "
D--Percent C is of B
E--Total hours used 9:00 a.m.-1:00 p.m., Monday-Friday
F--Percent E is of total possible hours 9:00 a.m.-1:00 p.m., Mon-Fri.
G--Total hours used 1:00 p.m.-5:00 p.m., Monday-Friday
H--Percent G is of total possible hours 1:00 p.m.-5:00 p.m., Mon-Fri.

@Rooms designated as classrooms but unused except for special events.

Table 4b

INTENSITY OF USE OF M.I.T. CLASSROOMS

cont.

A. Total number of rooms designated as classrooms-----169

Total possible hours, 9:00 a.m.-5:00 p.m., Monday through Friday---------6760

B. Total number of rooms used as classrooms----------153

Total possible hours, 9:00 a.m.-5:00 p.m., Monday through Friday---------6280

C. Number of hours actually used----------2870

D. Use factor for A-----42.4%

Use factor for B-----45.6%

E. Total hours used 9:00-a.m.-1:00 p.m.----------1657

Hours possible in A----------3380

Hours possible in B----------3140

Use factor for A-----49.0%

Use factor for B-----52.6%

F. Total hours used 1:00 p.m.-5:00 p.m.----------1213

Hours possible in A----------3380

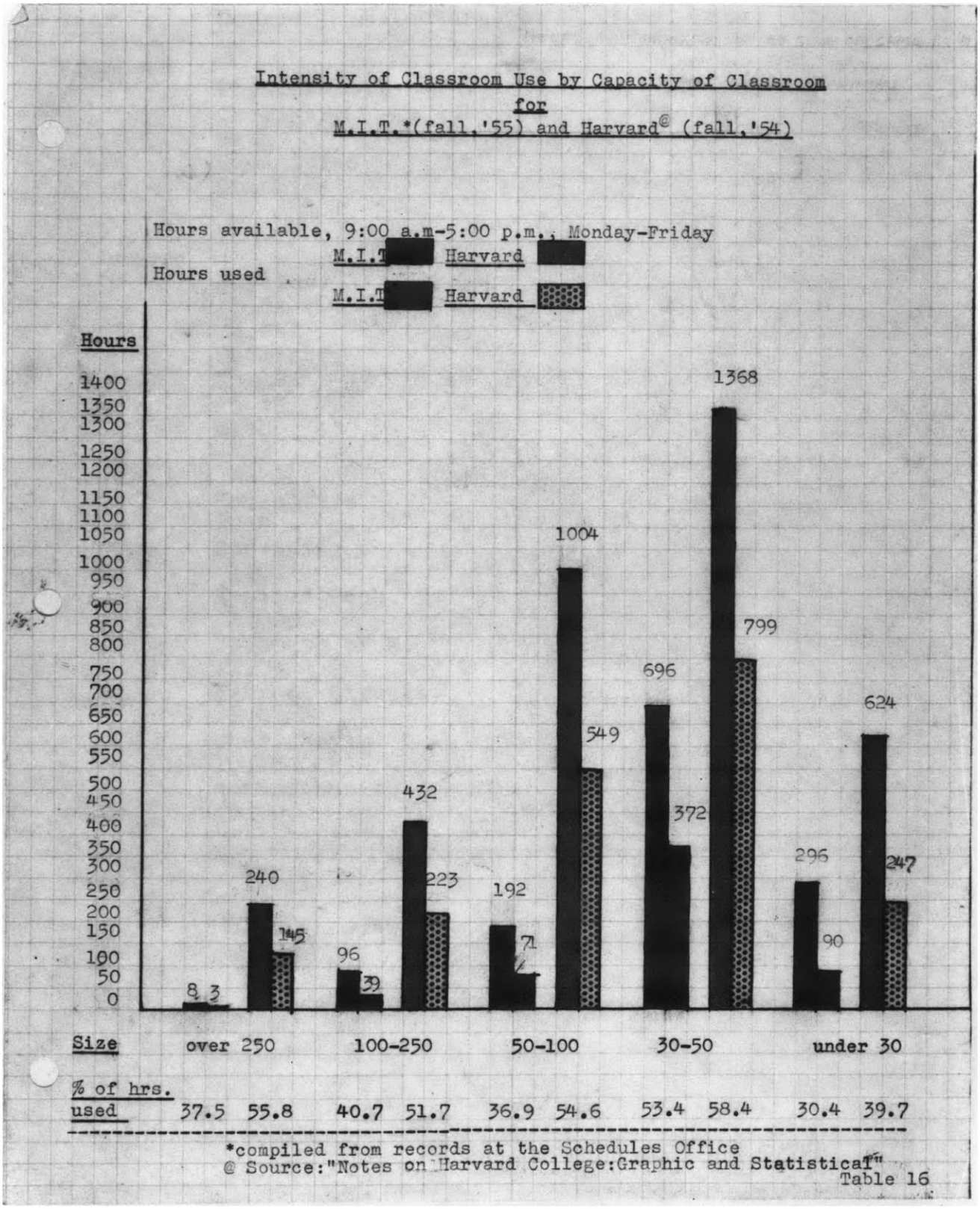
Hours possible in B----------3140

Use factor for A-----37.0%

Use factor for B-----38.7%

Source for Tables 4a and 4b----Schedules Office records

Graph 2



*compiled from records at the Schedules Office
@ Source:"Notes on Harvard College:Graphic and Statistical"
Table 16

Table 5

FIRST AND SECOND YEAR SATURDAY CLASSES
AT M.I.T.--1955-6

Year	Course	Lectures or Sections	3-hr. Labs	2-hr. Labs
Freshman				
	Physics	6	4	
	Chemistry	8	4	
	Math	14		
	Humanities	14		
	Graphics			6
Sophomore				
	Physics			
	8.04	7	2	
	8.041	3	2	
	Chemistry			
	5.12	10		
	5.13	1		
	Math			
	M22	12		
	M221	4		
	Humanities			
	H22	20		
	Surveying			
	1.02		1	
	Applied Mech.			
	2.002	6		
	Strength of M.			
	2.04	2		
	Introd. Circuit			
	6.01	2	1	
	Chem. Engin.			
	10.28	1		
	Aeromechanics			
	16.00	2		
	Total	112	14	6

Source: Registration folder, fall term, 1955-6

Table 6

BUILDING DISTRIBUTION OF CLASSES BY DEPARTMENTS AND SPECIAL COURSES

Course	Building numbers: 1	2	3	4	5	6	7	8	10	12	14	16	20	24	31	33	35	52
I	71*				1													
II	60		37		26		1								6		11	
III		1		4	2			12							1		9	
IV			5		2		2											
V		50		26		7		3	1									
VI	2	8	22	39	17	2		24	4						3			
VII					1							3						
VIII		59		23	1	11		16	8	1								1
IX																		
X	1			6	1			3	1	39				2				
XI																		
XII				1						1				5				
XIII	1				24													
XIV	2	45		1							7							27
XV																		43
XVI															1	25	1	
XVII			1		13													
XVIII																		
XIX				1										9				
XX					1							13						
H	1	80		1							8							
N										4								
M	1	127			3			1										
D			26															
L		12		2			1				17							
E		11		1							5							
MS				4					1				58					
MU		4																
total:	140	397	91	109	92	20	4	59	15	45	37	26	58	16	11	25	21	71

*Numbers represent total classes and sections, not total hours. Laboratory courses are not included. Figures derived from Schedules Office records.

DEPARTMENTAL OFFICES AND LABS

Unfortunately the bright outlook for classroom space does not extend to departmental laboratory and office facilities. In fact, Buildings and Power has been converting some classrooms to other uses as the demand increases.

"When we see a growing department," says one B&P official, "we try to locate a classroom or two next to it to be converted when needed. This way we can get and hold onto usable space for very little expense."

The writer was unable to do the same kind of detailed survey on these uses as on classrooms. Only a rough estimate of conditions can be given, using data from several sources. But it will provide some idea of the extreme congestion now hampering activities.

In 1950, Buildings and Power conducted a space survey of departmental facilities. These findings are summarized below in Table 7.

At that time, a total of 914,285 square feet*(or almost 50% of the 1,882,373 square feet devoted to academic, administrative and special uses) was devoted to deparmental labs, offices, drafting rooms, and storage.

Since then, 597,232 square feet of space has been added to the plant (excluding dorms, recreation buildings, and the Compton Lab) and 71,500 square feet demolished (excluding Building 22 which was in dormitory use at the time of this survey, later returned to research use, but shortly thereafter demolished) making a total increase of 525,372 square feet.

---

*Subject to rounding errors within Table 7

Table 7

SPACE DEVOTED TO DEPARTMENTAL USE----1950 (in ft^2)

Course		Offices	laboratories TU*	TG*	R*	D*	Total Labs	Drafting Rooms	Service	TOTAL
I	CE	7,000	655	5,690	9,825	7,855	24,025	9,080	3,350	43,455
II	ME	23,920	50,820	13,790	13,015	20,495	98,120	15,415	16,165	152,670
III	Met.	13,050	19,740	2,590	9,245	25,990	57,565	410	12,295	83,320
IV	Arch.	4,250						10,455	5,780	20,485
V	Chem.	12,540	25,530	3,085	19,455	8,665	56,735		7,405	76,680
VI	EE	28,375	27,305	7,055	3,322	21,288	58,970	3,560	12,505	103,410
VII	Bio.	3,940	2,900	1,850	7,545	1,290	13,585		1,485	19,010
VIII	Phys.	12,965	15,520	3,000	19,695	765	13,980	255	6,655	58,855
X	Ch.E	10,355	6,795	11,270	6,470	6,845	31,380		345	45,220
XII	Geo.	4,420	4,065	1,300	3,380	1,105	9,850	260	1,080	15,610
XIII	NA	4,645	1,060	670	1,470	670	3,870	10,710	4,060	23,285
XIV	Ec.	4,875	180	200	970		1,350		420	6,645
XV	BEA	3,660	1,650				1,650		600	5,910
XVI	AE	27,725	225	4,235	3,575	36,835	44,870	8,475	8,730	89,800
XVII	BE	2,105	880	1,155	1,530	845	4,410	2,040	875	9,430
XVIII	Math	8,335				525	525		580	9,440
XIX	Meteo.	4,550	130	130	130	1,235	1,625	1,690	1,210	9,075
XX	FT	2,320	2,470	3,755	5,865	375	12,465		2,100	16,890
English		4,830							330	5,160
Graphics		2,080						7,620		9,750
Lang.		1,215								1,215
Mil. Sci		5,165	2,550				2,550	4,195		9,570
Acoustics Lab		3,300		260	600	3,230	4,090	260	3,600	11,250
Nucl. Sci.		5,385			18,945	415	19,360	1,145	10,595	36,485
RLE		9,300		750	19,830	2,520	23,100	600	11,800	44,800
Spectroscopy					6,720		6,720			6,720
TOTALS		210,305	162,475	60,875	151,587	140,948	515,795	76,221	111,965	914,285

*TU--undergraduate teaching labs TG--graduate teaching labs
R--research labs D--special research (govt. and ind.) labs

Source: 1950 Buildings and Power space survey

Of this addition, four large buildings comprising 451,272 square feet or 86% of the total are devoted to specialized academic uses.

Building 14 - humanities, soc.sci., & library..	148,773	ft^2
Building 16 - biology and food technology.....	108,835	
Building 35 - Metals Processing Lab.....	67,507	
Building 52 - econ.+ ind. man.,Dewey Lib.,.....	126,157	
(also faculty club)		
	451,272	ft^2

The bulk of the remainder is represented by the Kraft and Whittemore buildings, housing specialized DIC activities not covered by the 1950 space survey.

Now, let us examine what these four new buildings have meant to the redistribution of facilities. As Table 7a below shows, they have allowed certain activities to grow outside the main plant, but have actually produced little relief within.

Table 7a

Space Vacated by Departments, 1950-5 due to new construction

English	5,160	ft^2
Languages.....	1,215	"
Economics (XIV)	6,645	
Ind. Man. (XV)	5,910	
Biology (VII).....	19,010	
Fd. Tech. (XX)	16,890	
Machine Tool Lab	20,000	
	64,830	ft^2

Although each of these departments was now supplied with ample space for its activities, the total amount vacated (all in the main complex) was about seven percent of the space then devoted to departmental use..not too much growth room for others.

(Note: We have not included the other half of the 1,882,373 square feet in use during 1950 in this discussion for the following reasons: We can assume that this was devoted to administrative, classroom, maintenance, and special DIC use. Maintenance demands have remained about stable. Administrative office space has actually increased--figures unavailable--. About 35,000 square feet have been added to DIC and special research, but their demands have gone in step with the supply. Unfortunately, the area figures on classroom space are unavailable, but we may assume a substantial amount of conversion to other uses has taken place since 1950. At any rate, changes in the rest of the plant at least cancel themselves out.)

The new Compton Lab will relieve some congestion, but will not free substantial space where it is needed most. Nuclear Science and the Research Lab of Electronics will take over most of its 135,000 square feet. They leave behind about 50,000 square feet...partly in Building 6 but mostly in Building 20. The latter is a dismal "temporary" wooden building whose use can not be continued much longer, but chances are that the vacant space will be snapped up immediately for specialized research. Building 20's location and character will not allow for expansion of departmental activities now located within the main plant.

In Buildings 2, 6, and 8 three departments need to expand to take care of existing demand, but can't--math, physics and chemistry. Located as they are, expansion of one would necessarily take from another.

On the other side of the main complex, civil engineering--originally not a laboratory oriented field--is now carrying out a growing amount of research on subjects like highway construction and does not have sufficient research quarters. Getting those to home, the office facilities for

the Architecture and Planning School are inadequate and scattered.

--- --- ---

When a department adds staff members, from research assistants on up, it has to provide them with a desk or office space. This means cramped offices and a loss of more classrooms and laboratories, and, due to the enrollment increase in the last five years, the faculty alone has increased by about 80 and junior staff by over 100.

No department has more than enough space. Others besides those mentioned have major problems, and still others--to be discussed in Chapter IV- are at a point of incipient growth which they will not be able to foster without substantial new facilities.

Drafting Rooms

Table 7 shows that drafting rooms consume a relatively small proportion of the floor space. We have no figures on the number or location of drafting rooms, but B and P says they have been somewhat reduced over the past few years and that they receive on the average 12-16 hours of use a week--or less than 50% of the time available. Many of these rooms are regularly taken for first and second year quizzes where several sections have an exam at the same time. Due to the highly specialized use of drafting rooms, the existing stock has little flexibility and cannot be reduced to accommodate other activities, even though the present use factor is low.

ADMINISTRATIVE OFFICES

There are no figures on the space consumed by administrative offices. A number of officials have said, however, that they too are sorely cramped for space. Building 3 is largely in administrative use, but sizable installations are also scattered through buildings 1, 5, 7, 10, and 24..making long walks necessary for some administrative personnel and making direction-finding difficult for visitors. Any expansion of administrative office space would take from departmental space and vice versa.

DIC and DDL

Again we have no figures except for the special buildings...Kraft, Barta, Whittemore, and Building 80, totalling 171,735 square feet. DDL activities, except for the Instrumentation Lab are now largely associated with project Lincoln in Lexington and in Bedford. Officials from both DIC and DDL say that their existing facilities are sufficient for their needs, and they do not expect an increase or decrease in activity which would disturb the balance.

LIBRARIES

Present library problems are largely ones of efficient use of existing space, not lack of space.

Within the academic plant, therefore, space needs for offices and laboratories are acute. There is some flexibility

and unused capacity in the classroom stock and drafting space is adequate. Library, DIC, and DDL research use have sufficient, if not ample, accommodations.

HOUSING

Table 8--Facilities

A.

Distribution of Student Housing---1955-56
Undergraduate Dorms on Campus

Yr. blt.	Dormitory	ft^2 area	capacity	ft^2 (gross)/student
1916	Ware, Atkinson, Runkle, Holman Nichols, Craft	64,450		
1924	Bemis	24,679		
1928	Goodale + Walcott	49,358		
1931	Munro, Hayden, Wood	74,037		
		212,524	620	344
1949	Baker House	135,650	350	387
acquir. 1950	Burton House	145,800	600	242
	Total	493,974	1570	308 (av.)
	Married undergraduates in Westgate & Westgate West		90	(See table on grad. student accomod.)
	In fraternities on campus		120	
	Total on Campus		1,780	

Undergraduates Off Campus

In fraternities	880	approx.
In women's dormitory	17	
Commuters with homes in BMA	400	approx.
Out-of-town students in rooming houses or apartments	558	approx.*
	1,855	

Total undergraduates	3,655
Percent housed on Campus (excluding frats)	45.5
Percent housed on Campus (including frats)	48.6
Percent housed off campus	51.4

* Includes 60 married students.

Graduate On Campus Accomodations

Yr. blt.	Dormitory	ft^2 area	capacity	Ratio
1938(acq.)	Graduate House	173,382	450	384 ft^2/family
1946	Westgate	47,850	(100)*	478 /family
1947	Westgate West	104,862	(180)*	580 /family
			190[a]	
			640	

% of graduate students housed on campus= 28.0 (Total graduates approx. 2,000.)

* Includes married undergraduates.
a Total graduate married residents

Table 8B
Staff On - Campus Accomodations

1938(acq.)	Bexley Hall	53,250	48	1,100 ft^2/family
1949	100 Memorial Dr.	--	50	
			98	

Table 8 below indicates the impact of recent living unit acquisitions by showing the percentages of total enrollment housed in Institute accomodations* at different periods since 1916.

Table 9
Enrollment Housed - 1918 - 1956

Year	Total Enr.	No. of Students Housed	Percent
1918-19	1,819	200	11.0
1925-26	2,813	296	10.6
1928-29	2,868	430	15.0
1932-33	2,831	620	21.8
1939-40	3,100	991	32.0
1950-51	5,171	2,300	44.5
1955-56	5,659	2,300	40.7

Note: While the percentage has increased since the beginning of the war, there has been a slight decrease over the past five years due to larger enrollment.

To illustrate the unfilled nature of the housing demand,

Table 10 below presents the waiting list figures for the fall of 1955.

Table 10
Waiting List

Undergraduate Dorms	150
Graduate House	175
Westgate and W.W.	270
Total	595

The actual demand is possibly higher than these figures indicate, since many people, told at the beginning of the year that accomodations are unavailable, probably find other quarters for which leases are required.

---- ---- ----

A brief note on facilities within the dormitories: Baker House has its own dining room, which accounts for its somewhat higher ft^2/student ratio. Burton has no dining facility, and its residents must eat off-campus, in Baker, or at the Graduate House. It is presently accommodating more men than it was designed to hold (600 vs. 500). East Campus students eat at Walker or off Campus. All three dormitory complexes possess common room facilities, but only Baker has a lounge on each floor.

The Graduate House has its own dining room and common room arrangement in addition to other special facilities.

While each unit in Westgate and Westgate West is equipped as an apartment with private kitchen and bathroom facilities, their small size--especially for families with children--is pointed up by comparing their ft^2/family average with Bexley Hall's 1,100.

Average Rentals: Student Dormitories = $325-30/year..$32-33/mo.
Westgate and Westgate West = $45-55/mo. family

Residential Location

The following maps and tables deal with the residential distribution of the MIT community--undergraduates, graduates, faculty and administration, and DIC and DDL personnel with offices in Cambridge. Unfortunately non-staff personnel were not tabulated.

Map 4 - Undergraduates

The distribution clearly shows the effects of dormitories and fraternities. Of the 3,334 undergraduate residences tabulated, 85.3% or 2,843 are in the Central Boston-Cambridge sector. Of these we may assume at least 2,580, are within walking distance of the Institute in fraternities or dormitories. About 263 of the 2,843 live at home or in apartments and rooming houses--some undoubtedly within walking distance. Chances are, considering the number of student loggings in both the Back Bay and Cambridge, that most of the 263 are not true commuters but men whose homes are outside the city or state. Perhaps 80 of the 131 in Brookline live in frat houses, and we might expect a small percentage of the other 51 to be out-of-towners not living at home. Some of the 28 in Somerville and the 31 in Brighton may also be students who have taken accomodations outside the dorms.*

* The writer has accepted the Ryer Committee's assumption that somewhat less than 500 undergrads have taken non-Institute accommodations. It is possible, though, that this figure may be higher. Only 3,334 out of an estimated 3,650 were able to produce permanent addresses at the time of the Registrar's tabulation...which means that a goodly number may have been looking for outside rooms.

Aside from those living in the four above-mentioned communities, no doubt all other undergraduates are "true" commuters. Possibly some of the 60 married students on the Westgate waiting list are living in fringe suburbs like Newton and Watertown, but the writer does not believe their number is significant.

While dormitories can account for only 45% of the undergraduates, all told, over 90% live within the inner 5 mile ring. Only two communities outside this ring have over 0.5% of the population...Newton and Dorchester, and they are on the fringe. Commuting students outside the inner ring are scattered throughout the metropolitan area and beyond, largely to the north west.

Map 5 - Graduate Students

A much smaller percentage of graduate students lives in the Cambridge-Central Boston area...67% of the 1,841 tabulated, although the greatest concentration is still close to the Institute.

Six hundred-and-thirty of the 912 Cantabridgians would have accomodations in Westgate and the Grad House, and a few more might be in Bexley Hall and 100 Memorial Drive. Approximately 270, then, would live on the outside. Most of the 322 in Central Boston would be out-of-town apartment dwellers.

A much larger percentage of graduate students than of undergraduates can be found in communities like Brighton, Brookline (once eliminating the frats from the undergrad total), Watertown, Newton, Somerville, Belmont, Arlington, Waltham,

Lexington, and Bedford. This is undoubtedly due to two factors--proportionately fewer Institute accommodations for grad students than for undergrads, a higher percentage (about 25%) of married graduate students than undergrads (4.25%).

Most of these in inlying communities may be considered apartment-dwellers. Since Bedford, Lexington, Arlington, and Belmont are predominantly single-family residential communities, we can assume that most of the 150 there have purchased or rented houses (although Arlington and Belmont might provide some apartments), reflecting a higher income standard.

Proportionately fewer graduates are localized in the inner ring, and the scattering takes place throughout the metropolitan area with the greatest concentration--as with undergrads--in the north west sector.

Map 6 - Faculty and Administration
(excluding res. assts., fellows, and teach. assts.)

Chapter I noted the communication difficulties involved with a faculty dispersed over a wide area outside of Cambridge, and Map 6 shows that faculty and administration officials are indeed scattered...to a much larger degree than either student group. Perhaps the best illustration is to compare the percentages of the three groups for those living in the Cambridge-Central Boston area and those living outside the Metropolitan District as defined by the 1950 census (heavy black line).

	% in Cam.-Boston	% outside Metro. District
Undergrads.	85.1	0.87
Grads	67.0	1.41
Fac. + Admin.	33.2	3.56

Even within the Metropolitan District, there are sharp differences in the residential patterns. Faculty and administration are concentrated more in particular "prestige" communities than are the students.* Notice the high percentages in Concord, Lexington, Wellesley, Belmont, Brookline, Arlington, Newton, and Winchester, and the low percentages in the "low prestige" communities such as Brighton, Sommerville, and Waltham..and none at all in Chelsea, Winthrop or Everett. One can also assume that most of the 258 men within Cambridge live in the upper-income area around Brattle St., two miles from the Institute; or in 100 Memorial Drive.

The faculty and administration outside Cambridge-Boston also tend to locate in the northwest sector of the metropolitan area, although the high percentages in Newton, Wellesly and Weston tend to pull the distribution towards the southwest as well.

Map 7 - DIC and DDL

DIC and DDL personnel can be considered in between faculty and graduate students as far as income level is concerned. Unfortunately, we have no salary scales for comparison, but can assume that the supervisory personnel are on a pay scale similar to faculty members and that many of the regular research staff receive similar pay to a research assistant or lower-level instructor. The residential distribution reflects these

* These figures perhaps are somewhat distorted, since students whose homes are in the "prestige" communities would be likely to afford dormitory accomodations and not live at home.

assumptions. Proportionately more DIC and DDL people than Faculty and Administration live in Central Boston-Cambridge (41.75%), but less than either student group. There are sizable numbers in Arlington, Concord, Lexington and Newton, as well as in Waltham, Brighton, and Watertown. About the same number live in Somerville as in Wellesly or Winchester. The distribution here tends towards the northwest, too, with a slight bulge to the southwest.

Taken as a whole, about 70% of the MIT academic and research community lives within Cambridge-Central Boston. The rest of the group is distributed throughout the metropolitan area, but largely towards the northwest and southwest. Quincy is the only community outside this band with over 0.5% of the population.

This distribution also has a significant effect on the parking and transportation situation at Tech...an effect which will be discussed on page 100.

HOUSING CHARACTERISTICS

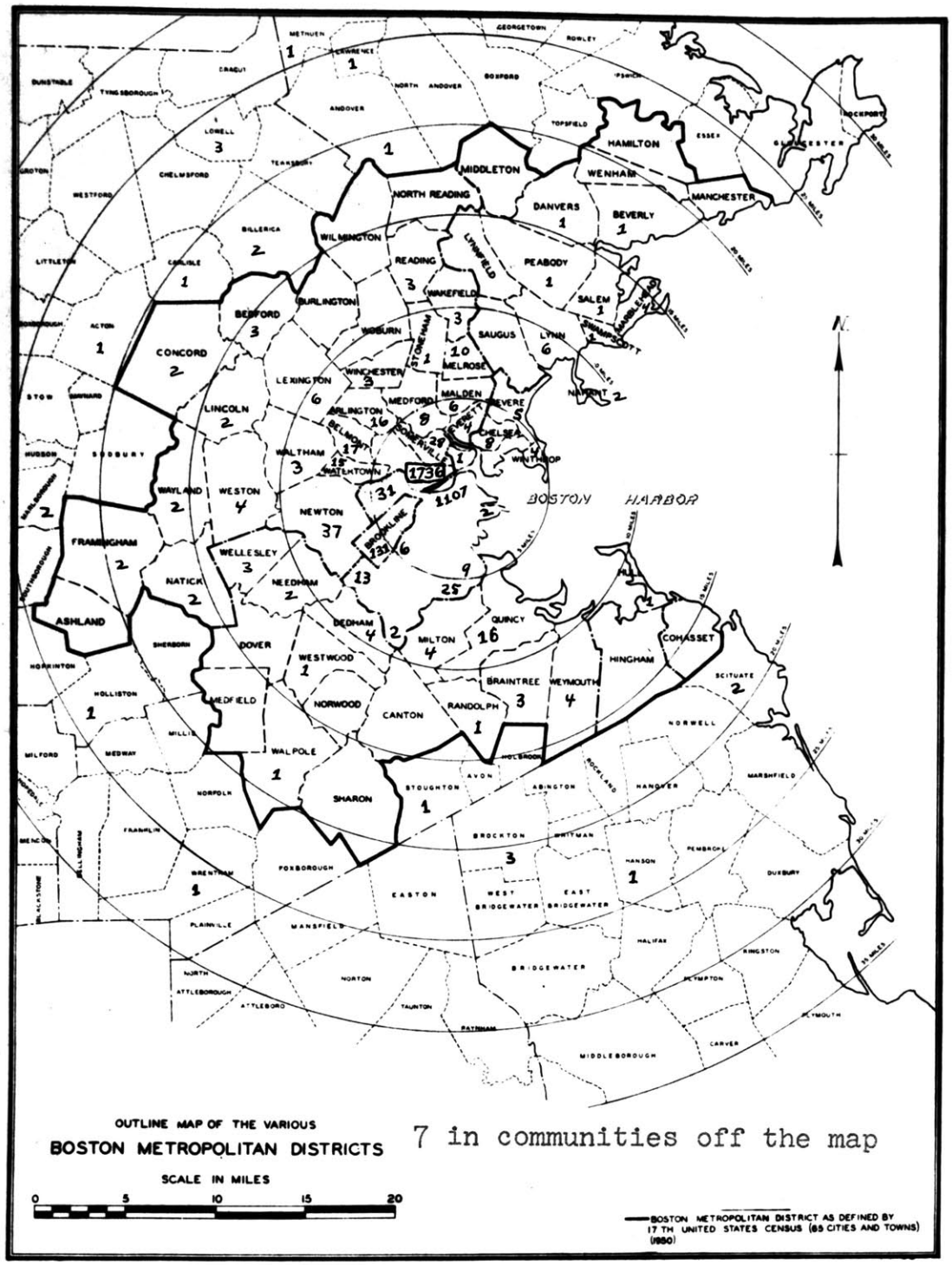
A thorough study of rentals and housing types will be necessary when the Institute actually gets down to program new facilities, but was impossible at this survey. Some rather general remarks may be helpful, however,

A recent preliminary analysis of off-campus housing accomodations available to Harvard students in Cambridge offers comments which might well apply to the MIT situation.

Map 4

Residential Distribution of Undergraduates

sample=3334



7 in communities off the map

Source: Registrar's records, 1955-6. See Table A4

Map 5

Residential Distribution of Graduate Students

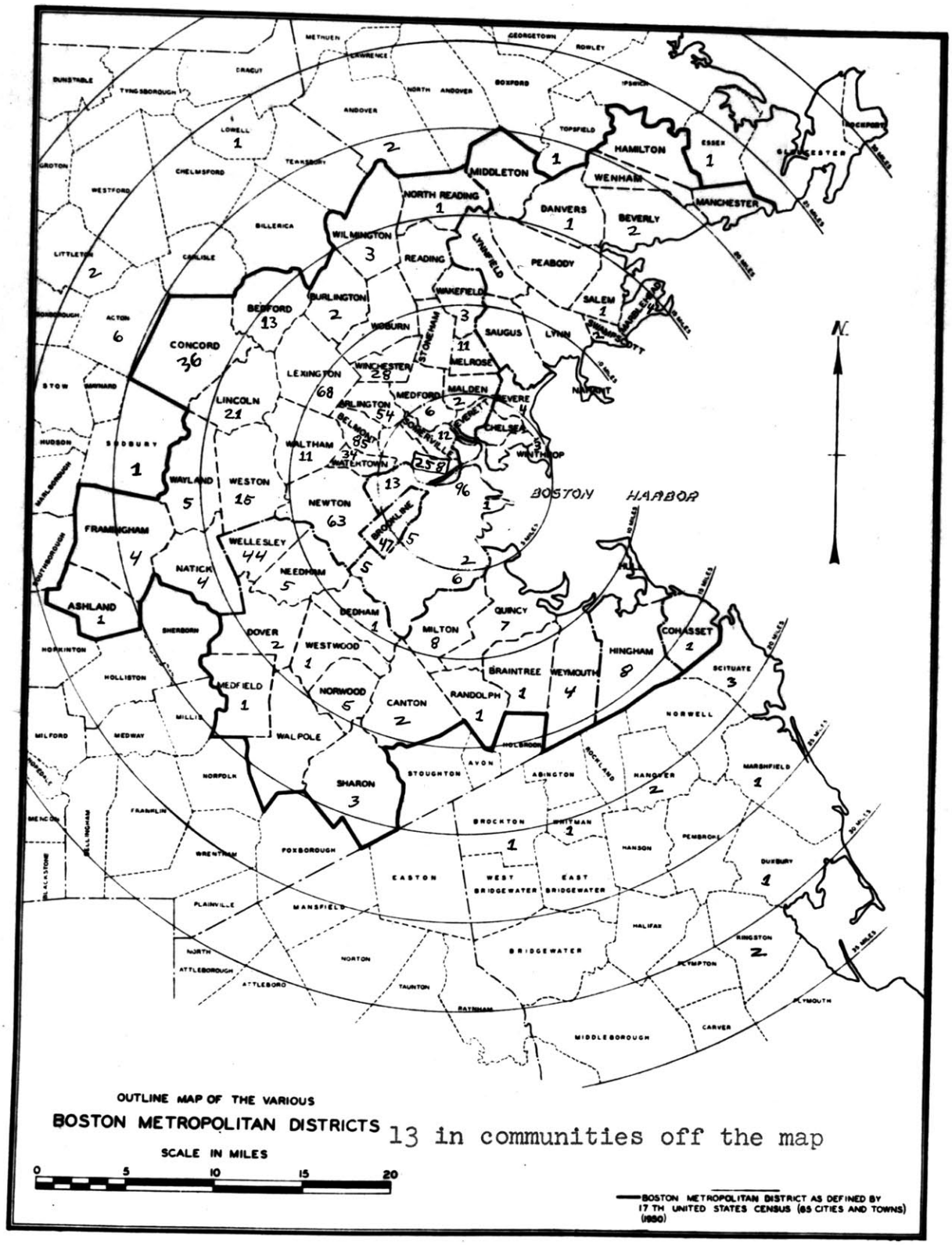
sample = 1841

Source: Registrar's Records, 1955-6. See Table A4

Map 6

Residential Distribution of Faculty and Administrative Officers

sample=1067



Source: Staff Directory, 1955-6. See Table A4

Map 7

Residential Distribution of Cambridge DIC & DDL Staff

sample=597

4 in communities off the map

Source: Staff Directory, 1955-6. See Table A4

"Since students, whether married or unmarried, usually require or can afford smaller accommodations than what may be considered necessary for a typical non-student family, they will probably find accommodations in converted houses. This has been the experience in Cambridge and presumably in Boston." (12, p 18)

- - -

"Another consideration which deserves further study is how 'functional distance' affects the metropolitan distribution of students. This concept measures not so much distance in terms of miles as distance in terms of time and cost... Moreover, the cost of transportation may be considered as a form of rent, so that in the minimum case of a student who makes only one daily round trip five times a week by bus, finds he is paying between $6.00 and $7.00 more per month." (12, p 8)

This factor of"functional distance" is extremely significant for MIT, where off-campus accommodations, except for some fraternities, are rarely within walking distance. While we have no exact figures, it is reasonable to assume that many of the Back Bay and Beacon Hill residents use the MTA bus line to get to Tech, and that all residents in the Harvard Square area, Brookline, Somerville, and beyond come by either public transit or auto. For those who use the MTA, $8-$10 a month in fares is more reasonable than $6-$7...and for automobile drivers the cost may run to $30 a month or more.

Let us see what effect this has on the real cost of off-campus accommodations.

For rooming houses, rooms in private homes, and rooms in apartments "the student will pay betwen $250-$400 for the school year, or between $6.50 and $10.00 per week." (12, p 17)

If transportation is not a factor, some of these accommodations compete favorably with dormitories, where the average rental is $325-30. When the student must commute, this cost

advantage is eliminated (i.e., minimum off-campus rental becomes $330 for 10 months and in all probability few places can be found at the minimum.)

For the married student living outside of Westgate or Westgate West the financial burden is still greater. On campus apartment rentals average $45-55/month. The Ryer Committee estimated that the average rentals paid in the metropolitan area were from $85-100 a month. Not only do the two base rates exhibit great disparity, but when transportation is considered, the gap becomes enormous.

A thorough income analysis should be in order, but for now we can assume that most married students--even with outside incomes--find the high rents a definite strain. The tuition rise to affect all students will put even more severe pressures on the off-campus resident.

While Alonso notes that there seems to be a surplus of single rooms in Cambridge, he mentions a definite apartment shortage, at any price.

"In December, 1955, the Housing Registry (Philips Brooks House) had a listing of approximately 110 addresses with rooms for rent. The number of vacant rooms was presumably greater. Most of the vacancies listed were in rooming houses, where, because of the larger number of rooms, there is more likelihood of one being unoccupied." (12, p 19)

"Corresponding to the surplus of rooms there appears tob be a shortage of apartments, having as its probable reason, the increase of married students...in 1955 of 635 apartments listed during September, only seven remained unrented after the September rush, and half of these, according to the Registry, 'for good reason'" (12, p 19)

This apartment shortage probably accounts for the large number of graduate students living in outlying apartment-type communities, like Brookline and Watertown. It also may be a factor (in addition to the "normal" desires for suburbia) in causing Faculty members and DIC-DDL personnel to take single family homes in more distant communities...i.e., if there were more decent apartments at reasonable rentals in the Cambridge Central Boston area, there would be more MIT personnel, paying less for transportation, living close to the Institute.

Alonso gives the following outlook for off-campus housing in Cambridge:

> "There can be no question that Cambridge's loss of population in the past few years has been a fortunate coincidence from the point of view of housing for Harvard students. It has also been noted that both the proportion of married students and the proportion of smaller families in the non-Harvard Cambridge population may be expected to increase. As a result, the proportion of tenants, both Harvard and non-Harvard, may be expected to increase in Cambridge, and many of the larger housing units in the area will be converted into smaller. This presents the danger of deterioration and blight in the long run. Where the Harvard population predominates this danger is more accute as tenants do not invest in upkeep and repairs and many landladies either 'milk' their property for profit or make a meagre living from it without enough money or foresight going into repairs." (12, p 26)

This might well apply to the MIT situation.

The preceding comments have been more to give a general picture of off-campus housing, than an attempt at a detailed analysis.

ATHLETIC PLANT

Table 11
Land and Buildings

Land devoted to athletic activity=809,600 ft^2=18.5 acres=
(17.2% of MIT land)

Land usable for athletic activity = 600,000 ft^2 or 13.8 acres

Facility	ft^2 area
Swimming Pool and Squash	30,035
Briggs Field House	8,635
Rockwell Cage	33,252
Sailing Pavilion	8,034
Boat House	17,625
Rifle Range	1,632
Walker Gym	8,000 (approx.)
	117,213

Except for a real gymnasium, which is sorely needed, the athletic facilities seem to be adequate for the present level of student participation (See Athletic Committee Report).

In 1955, 419 intramural teams competed in a 13-sport program...i.e., 3,570 men in 950 contests. Estimated duplication is 55-60%, so the actual number of participants was about 1,430. A total of 43 teams was fielded for intercollegiate sports.

It is important to point out that any new programs requiring field or gym use are close to impossible, and the expansion of existing programs is curtailed. According to the athletic department, it will be difficult to increase the present level of activity, to encourage greater graduate student participation,or take any sizable enrollment growth in the present

plant. There is also some conflict for field space between sports and various ROTC drills.

PARKING AND TRANSPORTATION

These are two of the most immediate problems. Actually MIT is not conveniently serviced by public transit. The Mass Ave. bus runs infrequently, and many people consider Kendall and Central Square subways the ends of the earth.

According to the population distribution maps, 5917 of the 6812 accounted for in the academic population (or 86%) live within the MTA district. This has not, however, contributed to any diminution of automobile traffic*. The others, scattered mostly in the northwest and southwest sectors near Routes 9 and 2 undoubtedly drive, since highway connections to MIT are good and fast, and since railroad and MTA transit is inconvenient. Combined fares from these distant communities to MIT are well over $1.00/day. (Even though automobile driving is actually more expensive than this, once transit fares mount up there is a strong tendency to drive, no matter what the cost.) People living in the other sectors would also tend to drive to work.

We have no residential distribution figures on the employed office and maintenance personnel (about 2,500), but Buildings and Power states that many secretaries are beginning to drive to work and are asking for parking permits.

*The writer has often been at the Kendall Square subway around 9:00 a.m. and has been struck by the small number of MIT people on the train. The Mass. Ave. bus <u>is</u> used rather heavily.

Table 12

PARKING PROCEDURES AT M.I.T.

Land area devoted to parking ---- 543,000 ft^2.*...% of total----11.6% land area

---

Parking permits:

Number of applications for parking stickers, 1955-6-----2937
(excluding resident students and Westgate residents)

Total granted-----2437

Distribution of permits:

commuting students	500
staff	1897
Physically handicapped and specials	40
	2437
resident students	90
Westgate residents	270
	2797

Number and location of parking spaces:

Location	Number restricted	Number unrestricted	
Main	245		
East	605		
West	206	64	
Vassar	65		
Zone D	190		
Sloan	280		
Burton	90		
Westgate	270		
TOTALS	1,945	64	2,009

Ratio of stickers to restricted spaces (excluding Westgate) --------1.5/1

Estimated number of illegal on-street parkers---------450

Source: Buildings and Power

*Not including the Kraft Building's 16,800 ft^2, which is in the nearby industrial district.

Parking Procedures (See Table 12)

A quota of stickers is issued to each department. No student within the MTA district may receive a sticker (although staff members can get them, but are discouraged) unless he shows special hardship or need. Resident students are allowed 90 spaces in the Burton House lot.

Actually, says a B&P official, the demand is greater than it seems from the 500 people refused stickers, since many Cambridge-Boston residents have stopped asking for permits and just park illegally. The volume of illegal parkers is greater than estimated on Table 12, since the West ends of Vassar and Albany streets are not considered in this total (writer's estimate....600).

Officials estimate that 1,000 visitors a day come to MIT, and parking space in the main lot has to be provided for many of them. In addition, about 150 temporary parking permits are usually in operation.

In order to assure maximum use from parking facilities, Buildings and Power issues from 1.4 to 1.6 times as many stickers as spaces available. Few places are left unfilled... to the contrary, there are often traffic jams as people with stickers circle around the East and West lots looking for space.

It is interesting to note that the Sloan Building lot has about 40 empty spaces at 10:00 a.m. each day, and is almost never filled, even though the policy is to let other cars in after the 9:00-10:00 rush. The lot is a 5-10 minute

walk from any other MIT building, and evidently drivers will rather take a chance at finding no place at all on the street than on using a sure spot which requires them to walk a bit. This may be related to the small amount of subway use at Kendall Square.

In the last few years, the great demand for parking, especially on East Campus, has eliminated much green space from the grounds. New buildings have eliminated parking space, and a vicious circle is being formed. New buildings create more parking needs and leave no place to fulfill them. What do you encroach upon next?

Part 3

THE ENVIRONMENT

It is common knowledge that MIT is in an industrial straight-jacket.

"We conclude," said the Committee on the Educational Survey, "that the urban setting of the Institute is both an asset in that it provides close liason with commerce and industry and a liability in that it gives rise to certain environmental problems inimical to teaching and research." (7, p 17)

Expansion is not the only problem. Now Institute policy-makers are questioning whether or not a residential college can be established in such a setting as exists. MIT today is a far cry from what it was when President (then MIT professor) Eliot wrote in 1869:

> "'..a technological school is best placed in a large city, in a great industrial center. A college needs quiet and seclusion; a technical school, on the contrary, should be within easy reach of works, mills, forges, machine shops and mines. The professors of a scientific school have need to be brought into daily contact with practical affairs to watch the progress of new inventions as they develop from day to day, and to know the men who are improving special industries. The students of a scientific school have a like need.'" (7, p 11)

Other needs are important, too, in today's Institute.

The following maps and tables will illustrate just how tight a squeeze exists. They deal with the area west, north, and south from the Institute to Central Square...stopping at Western Ave. and Prospect St.....about 1/2 mile to 1 1/2 miles in depth.

Map 8.....Generalized Land Use

This map indicates that a collar of industrial development, both light and heavy, extends around the Institute for a depth of 400-2,500 feet. Residential areas come behind the industry. Actually the pattern is not quite so clear-cut as the map shows, since there is a substantial scattering of blighted residences in the industrial area around Sidney St. to the southwest.

Though some of the firms can not be considered too healthy, this particular location holds excellent industrial advantages, both from the standpoint of transportation (the belt-line railroad and major highways) despite the congestion on Mass. Ave., and from the standpoint of accessibility to a large labor pool. It is doubtful whether any substantial outward movement of industry will take place, especially since the Cambridge tax rate is fairly low and since the zoning

regulations are so favorable to industrial development, (See Map 9), Notice that the zoning pattern follows right along with the land use.

Table 13 provides information on social characteristics and housing for the area coverdd by the land use and zoning maps plus Neighborhood 7 (between Western Ave. and Boylston St.)

Both the social disorganization and the physical blight of this section are clearly marked.....dense population, high percentages of crime and truancy, high percentages on relief roles, abnormally low rentals, low valuations, and insufficient recreational areas. Almost all the dilapidation in Cambridge (87%) is within this area.

In order to give some conception of land valuess, the writer has presented in Map 10 some maximum and minimum square-foot land values for the area south of Mass. Ave. In some blocks, where dilapidated residences predominate, values drop as low as $.25/ square foot or lower. Where industry or business predominates, close to Institute property, the values shoot up to well over $2.00/ square foot. When both land and building are taken into consideration, total valuation runs from $1.00/ square foot in the residential area to about $10.00 close to M.I.T.

(It is interesting to note that both the Simplex Corp. and Seymour Chevrolet have recently acquired several plots in the dilapidated district of Sidney St. close to their holdings.)

Although the complete value survey is not yet ready, the Planning Board suggests that this land value pattern probably

holds throughout the area under consideration...blighted homes low, industrial land high...which means that the Institute borders on higher-priced land in all directions, land which is difficult to acquire for institutional use.

****

CONCLUDING NOTE

This chapter has tried to indicate something of the dimensions of MIT's physical plant, and of the relationship between type of use, intensity of use, and facilities available. We also tried to examine the character of the surrounding environment.

Assuming, for the moment, that MIT will not grow substantially beyond its present activities and that no desire to change the present character of the physical plant exists (Neither assumption is valid.), what seems to be the present state of need?

1. Classrooms are not needed.

2. Teaching laboratories are sufficient, but some departments require extra research and office space, and administrative activities need re-centralization.

3. A larger percentage of the student body and perhaps some staff members should be housed closer to MIT if only for economic reasons.

4. The athletic plant requires an adequate gymnasium and more land for intramural sports.

5. There should be more parking space for the volume of autos.

At this point we will not try to assess the magnitude of each need or its priority relationship to others, since whatever might be done now for the present problems strongly hinges on what the Institute will or can do in the future about its size, type of programs, land policy, and "character".

The reader, therefore, might keep the present needs in mind as we move into the next chapter, which will discuss the future and how the present relates to it. There we will attempt to establish the magnitudes of needs, their relative weights, and the expansion alternatives.

- - - - -

Table 13

POPULATION AND HOUSING CHARACTERISTICS OF THE SOUTHEAST SEGMENT OF CAMBRIDGE* (1954)

index	% of City	Southeast Segment Rate	Rest of City Rate
AREA			
residential area	30%		
POPULATION			
total population	47%	132/acre	66/acre
population under 20	54%	43/acre	16/acre
		326/1000	244/1000
children 7-16	56%	19/acre	6.6/acre
		144/1000	99/1000
adults 65 and over	39%	81/1000	112/1000
non-whites	67%	73/1000	31/1000
foreign-born	51%	185/1000	156/1000
EDUCATION			
adults over 25 without high school diploma	57%	710/1000	390/1000
JUVENILE PROBLEMS			
Juvenile delinquency	77%	40/1000	15/1000
truancy	89%	13/1000	2.3/1000
WELFARE SERVICES			
4 private welfare agencies	67%	33/1000	14.5/1000
Aid to Dependent Children	75%	19/1000	6.1/1000
General Relief	83%	17/1000	2.4/1000
Old Age Assistance	53%	270/1000	152/1000
HEALTH			
new cases of TB 1949-1951	59%	3/1000	1.8/1000
HOUSING			
median rent	---	$25.72	$39.76
dilapidation	87%	79/1000	11/1000
no central heating	82%	514/1000	83/1000
single owner-occupied homes valued under $7,500	48%	670/1000	240/1000
tenant occupancy	47%	830/1000	742/1000
RECREATION			
City recreation areas over $\frac{1}{2}$ acre in size	38%	1.5 acres/ 1000	2.9 acres/ 1000

*The Southeast Segment is comprised of Census Tracts 1-19 excluding 9,16,17,and 18. Roughly this is Neighborhoods 1-5 and 7, or the area east of Harvard Square located south of Mass. Ave and East of Prospect St.

Source: Cambridge City Planning Board

GENERALIZED LAND USE-------

The environs of M.I.T.

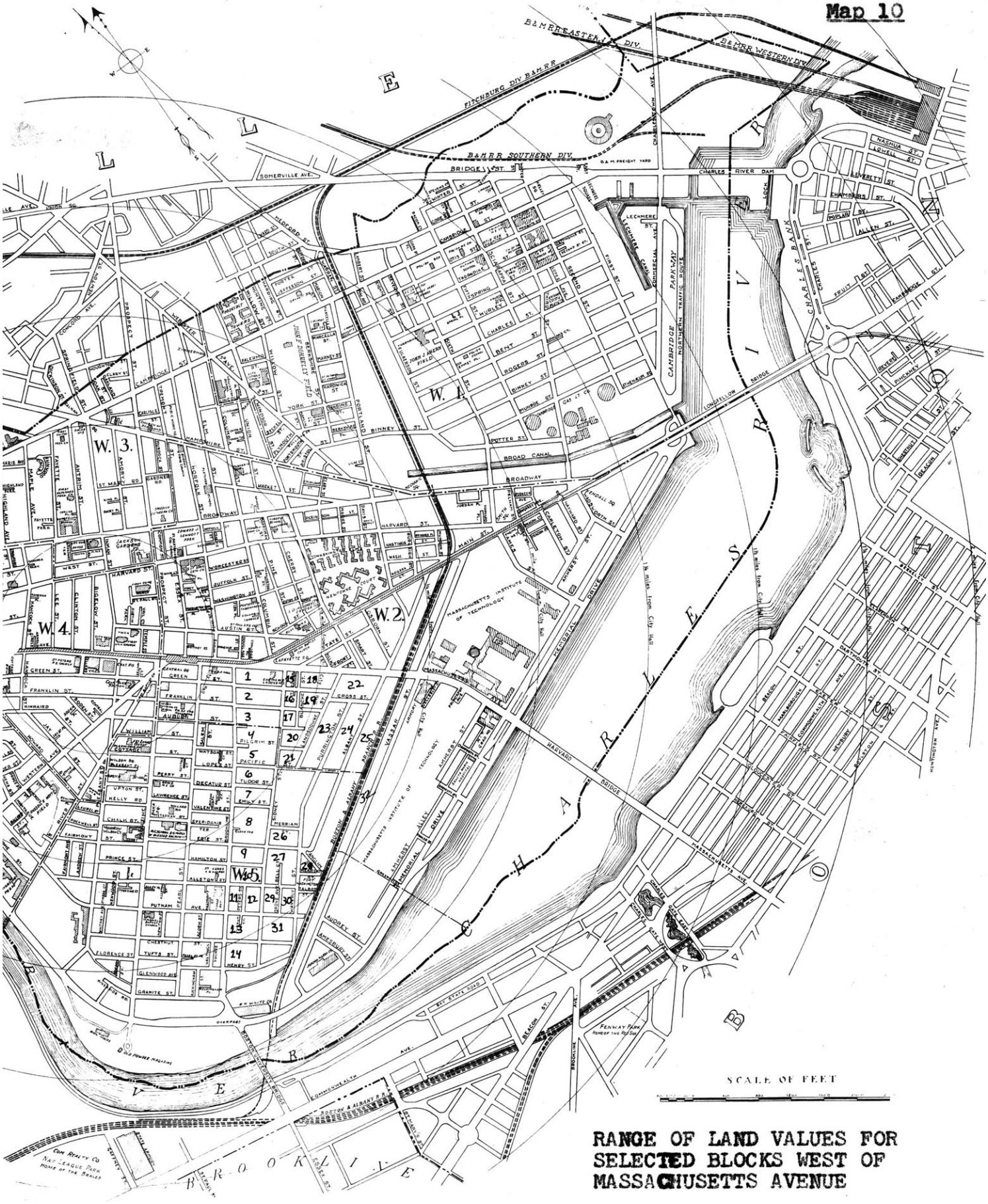
GENERALIZED ZONING PATTERN----
The environs of M.I.T.

Key to Map 10

Block No.	Lowest ft^2 values (land)	Highest ft^2 values (land)
1	$0.30	$7.40
2	.48	.62
3	.49	.61
4	.40	1.00
5	.33	.64
6	.40	.75
7	.39	.61
8	.26	.46
9	.40	.45
10	.18	.42
11	.30	.44
12	.30	.78
13	.30	.44
14	.22	.51
15	.95	.95
16	.56	.61
17	.38	.58
18	.37	2.74
19	.37	.76
20	.37	.72
21	.62	.62
22	1.03	2.40
23	.68	.81
24	.75	.88
25	1.00	1.20
26	.36	2.14
27	.20	.53
28	.22	1.01
29	.30	.78
30	.19	.37
31	.28	.56
32	.90	1.22

Source: Cambridge City Planning Board

Map 10



RANGE OF LAND VALUES FOR SELECTED BLOCKS WEST OF MASSACHUSETTS AVENUE

Key on facing page

CHAPTER IV---OUTLOOK FOR THE FUTURE

Any decision to meet a particular present physical need can not be made without first assessing its relationship to future requirements. Many demands conflict with each other, and to emphasize fulfillment of the "wrong" ones might prove disastrous. The Institute is no longer back in 1939 when ample growth room existed, and when new structures, parking lots and athletic fields could be successfully located around the main plant if only sufficient funds were available.

Now, money alone is not the problem. Our discussion of the surrounding Cambridge environment shows suitable land is at a premium. Our discussion of objectives indicates that new conceptions of educational philosophy are emerging which might have tremendous repercussions on the future physical plant. We also know that a powerful desire to "humanize" the MIT environment exists among the faculty and administration.

Above all, the war baby boom and national manpower requirements are exerting pressures on MIT to expand, the like of which have never been felt before in peacetime.

Every decision has to hinge on one decision--how big will and can the Institute grow? If MIT accepts more students, it will mean more staff, more offices, more parking space. It will also mean more intensive use of classrooms, laboratories, athletic plant, recreation, and housing facilities. Enrollment increase has a pervasive effect.

This chapter will be the most "subjective" in the thesis. In it the writer will examine the expansion pressures in the light of the objectives stated in Chapter I and the existing facilities described in Chapter III. Where objectives seem to conflict or have not been fully defined (viz. regarding commuters and women students) the writer will attempt to spell out alternatives. This should definitely be taken as an expredsion of opinion---not of Institute policy.

Our object is to expose the possible courses of action, and to recommend--based on the alternatives--specific long and short range development proposals. Section I will deal more with the quantitative aspects of each subject, while Section II will try to put the different alternatives together, evaluate them, and assign locational and time priorities.

SECTION I

The subjects treated will appear in the following order:

1. Enrollment
2. Staff and personnel increases and office needs.
3. Program Development
4. Academic plant expansion
5. Housing and community facilities
6. Athletic plant and recreation
7. Parking

- - - - - -

ENROLLMENT.....the question of size.

"What should be our policy with reference to increasing numbers? May we not be within measureable distance of a time when it will be necessary to impose artificial restrictions on our growth lest we become too large for effective management?" (1914 Pres. Rept., p 21)

"Any appreciable increase in enrollment would certainly lead, through overcrowding of facilities to deterioration in the quality of work done." (1931 Pres. Rept., p 11)

"Size has an important bearing on the character of every institution. (The War period)....has been accompanied both

> by progressivel diversification of activities and by decrease in unity of the MIT community....The question that confronts us is that of deciding at what point the gains achieved by growth become so costly as to make further expansion inadvisable....This question can not be answered by means of an explicit formula....and we can merely state that in our judgment, the optimum size may already have been exceeded." (7, p 15)

Enrollment expansion has been a continual problem except during a few depression years. Since the CES report appeared in 1949, MIT's total enrollment has not grown measureably, but it has also not experienced the decrease expected after World War II veterans no longer made up the bulk of the student body. All indications are that any future dimunition will be impossible. The question is, whether future growth is possible, desirable, or inevitable.

A number of reputable individuals have made esimates of future university populations. As the CES recommended, the Institute can not adopt an explicit formula for handling MIT's share, but it will be profitable at this point to review some figures on what the demand might be in the next 15-20 years.

Table 14

Population Figures for the U.S. 1930-54

	1930	1940	1950	1954
population (in 000's)	122,400	131,600	150,700	165,000 (estim)
births (in 000's)	2,304	2,360	3,554	4,120 (estim)
birth rate (per 1,000)	18.8	17.9	23.6	25.0 (estim)

(Source: Stratton,J, "Trends in MIT Education", "Tech Rev." Oct. 25, 1954)

Table 15

Anticipated College and Univ. Enrollment 1952-1970

1952	2,148,000
1960	2,800,000
1970	4,300,000

(Source: Stratton, J.; "Trends in MIT Education, "Tech Rev." Oct. 25, 1954)

Table 16

Anticipated Freshman Classes

1955-6	488,000
1960-1	657,000
1965-6	833,000
1968-9	912,000

(Source. Octoby, Mugge, and Wolfle; "Enrollment and Graduation Trends from Grade School to Phd.", "School and Society" Oct. 1952)

Table 17

Anticipated Degree Totals

Year	Bachelor's deg.	%*	Master's deg.	%@	Doctor's deg.	%&
1955-6	283,000	12.9	47,000	17.7	5,940	2.12
1960-1	329,000	14.4	61,300	18.8	6,790	2.20
1965-6	439,000	15.9	90,800	20.0	8,960	2.27
1970-1	604,000	17.4	124,700	21.1	12,230	2.35

*percent of population age 22
@percent of Bachelor*s degrees awarded one year earlier
&percent of average of bachelor*s degrees given in the same year and bachelor*s given four years earlier.

(Tables 16 and 17 from Oxtoby et al are estimated from trends in Office of Education reports and Census figures.)

Within the next 15 years, President Killian said in 1954, the United States must double its educational facilities. To do so on the same level as now, he continued, would mean as much college plant construction as there has been in the past 300 years.

From the above estimates, it seems obvious that MIT will not be able to say we will accept such and such a percentage of the growth in applications. If the estimates have any accuracy,(and if we can assume science and engineering candidates will increase at least in the same proportion as others), they indicate at least a doubling of BS canditates by 1970, and a tripling of men seeking advanced degrees. MIT can not set its limits in terms of percentages of national demand....rather the limit must be one of actual numbers. How many more freshmen can we conceivably admit before anarcy reighs? What total limits can we set on our graduate body?

Obviously the limits have something to do with the demand, but they are more clearly seen by looking at the demand through educational objectives and facilities limitations. Although enormous pressures exist, we are not in a wartime situation where technicians must be trained at all costs and inconvenience. Nor are we Soviet Russia where training in techniques outweighs all considerations of extra-curricular life and an environment conducive to emotional development.

We might, therefore, begin with three postulates:

1. MIT is going to grow somewhat because no educational institution can function or meet its obligation to society by resisting society's needs.
2. MIT is not going to grow beyond a point where either curricular or non-curricular objectives are put in jeopardy.
3. Whatever growth does occur will be a selective one....i.e. it will oocur in areas where expansion can best be handled in line with objectives and facilities, and it will not occur where undue strains will be produced.

WWhere to Expand--Undergrad vs. Grad

In a study of manpower needs which is still in progress, the Dean of Engineering found that 175-200 institutions in the United State offer similar (in scope at any rate) undergraduate programs to those at MIT. He also discovered that not more than 15-20 had a similar emphasis on graduate work. Of course, the number of Institutions which offer BS degrees in science (not in engineering) is still greater. These findings have an important bearing on the direction of MIT's expansion.

The big bulk of applications over the next 15 years will be from those seeking admission to the undergraduate school. At the same time, however, other existing technical institutions will be able to accommodate the undergraduate demand much better than the graduate. In addition, (as we noted in Chapter I and as Senator Benton forcefully stated in a recent "New York Times" article) the greatest demand from industry, research, and teaching will be for the highly-trained specialist who can carry out complex projects and who can teach the bumper crop of scientists and educators to come. Our technical institutions are less well equipped to handle and train these men, and therefore the great burden falls on the few like MIT who are now emphasizing their graduate schools. As Provost Stratton has said:

> "But, while the size of the undergraduate body is a primary concern, the size of the grad school also requires study. The grad school cannot be expanded indefinitely, of course, but the nation is in great need of advanced scholarship of the highest caliber, carried out in sufficient amount. Especially in the

> last quarter-century, MIT has been called upon to carry more than its share of such responsibility. The future may make similar demands." (23,p 82)

It is also quite possible that the baby boom will lead to a large expansion of some lesser-known technical institutions, in the same way as it has brought the development of the junior college system. A network of regional technical colleges seems quite as reasonable as the network of regional junior colleges which has already begun to grow in the Far West. By training graduate teachers who could participate in developing such a system, the Institute might make a greater contribution than by greatly increasing its undergraduate body.

Dean Soderberg has told this writer: "Those who apply to college are going to be educated, there's no doubt about that. The question is how and by whom." Considering the need and the amount of money beginning to flow into colleges from Corporations and the Federal Government, and considering that it is easier to develop an undergraduate program from an already-existing core (viz. something like Wentworth Institute) or from scratch than a graduate program, a large expansion in undergraduate facilities among other institutions is probable.

Other factors lead to the belief that here growth will be emphasized in the graduate school rather than in the college.

1. Undergraduate objectives. The desire to create a residential college with a humanized environment and great opportunities for extra-curricular activity is very strong. Rather than making any large increases in the undergraduate school within the near future, first attention should go to

achieving this goal for the present size of enrollment. Any large increases will compound the problems and make future action all the more difficult.

The same might be said about the increasing emphasis on scientific fundamentals and principles. Now in its embryonic stage, this emphasis may make sharp changes in undergraduate curriculum...sharper still than from the humanities program. It may require, (See P122) a greater number of large classrooms and labs as well as more intensive use of smaller facilities....for the same number as enrolled now. Any major increase before this program is thoroughly developed will be impossible if a program is to succeed.

The writer believes that MIT is strongly committed to developing a unique brand of university education for its undergraduates which might well serve as a model for other institutions, and any model-building will be impossible if the key materials are unworkable.

2. While undergraduates rarely know what their special field will be with any definiteness, graduate students apply to and are selected by particular departments. By concentrating on graduate growth, the Institute can be more selective. It can hold down growth in sorely taxed departments and channel attention towards those which are undersubscribed. It can not exert such selectivity in the undergraduate school.

3. Another factor leading towards expansion in the graduate body is the relative de-emphasis on graduate student housing to be provided by MIT. Although graduate housing is considered important, there is no goal to establish a residential graduate school, no commitment to house as large a percentage of graduates as undergraduates whatever that percentage might turn out to be.

The Institute has recognized a greater desire for privacy, for "free choice", and a greater sense of maturity among graduate students. While it is committed to establishing a graduate center of some kind, MIT can expand its advanced programs without as much concern forhousing as in the college.

4. A final reason for emphasizing graduate growth is the availability of advanced students to act as researchers on expanding research projects and as teachers in the undergraduate school---skills of value to the Institute which the younger men do not possess.

Great dangers exist in concentrating too much attention on the graduate school, however, and they stem less from numbers than from attitudes. Conceivably the college student could become a forgotten man. Conceivably the goal of a "university based on science" might be submerged under a system that concentrated too much on turning out omnipotent Phd.'s. If a graduate program grows in size and importance, it seems incumbent upon more key faculty members to adopt attitudes like those of Geology Chairman Shrock and a few others who believe that undergraduate teaching is an important and exciting phase of their work. Prestige and significance must be attached to college instruction. Just because more potential teaching assistants may be around in a few years, it does not mean that they should take the <u>place</u> of top faculty personnel.

<u>How Much to Expand</u>

Any suggestion as to actual numbers has to be made with more careful analysis than can be conducted here. With the few

yardsticks available, and recognizing that any increase would mean sizable expansion in facilities, we will make some speculations about the size of MIT in 1960 and 1970.

The Ryer committee assumed a possible expansion of 400 over the next 5-6 years. The writer feels that unless the administration takes this figure as an unchangeable absolute, the actual increase will be somewhat higher by 1960, and that by 1970, MIT will have between 1500-2000 more students than in 1955. This represents an increase of 26-36 percent compared with a 55 percent increase between 1940-55.

How to justify 1,500-2,000

The prediction is based on three major assumptions. They are:

1. Undergraduate population will increase, but by a small amount.

2. Graduate population will grow sizably, but not to such a point where it will exceed or even equal the college group. At either one of these two points, the character of MIT's program and objectives would undoubtedly have to undergo marked changes. Perhaps this might happen some day, but our projections are based on what seem to be the current trends. Judging from the writer's interviews, there is some substantial support for this view.

3. This degree of growth would require more facilities than are now available. Land limitations are such (see Section II, Chapter IV) that the writer does not believe MIT can add many more than 2,000 students and still remain concentrated in Cambridge.

While the actual number may be less than 1,500-2,000, it can not be much greater without either relocation or a substantial decentralization of activities to other locations in the metropolitan area.

Relocation might once again prove desirable, but it seems inconceivable that MIT would abandon its gigantic investment, strategic location, and ties with Cambridge within the foreseeable future. There are more alternatives available for utilizing the present site with some expansion than there were in the Boston of the 1900's.

As the suburban areas get built up with increasing intensity any relocation would have to be at a great distance from the central city if it were to have adequate land. The disruption it would produce is unpleasant to consider. Moving to Lincoln, for instance, is a lot different, even with the automobile, from moving just across the Charles. While relocation is not to be dismissed as a very long range possibility (30-50 years), it can be forgotten for the time scale of this report.

Some selective decentralization is possible, nay, inevitable as subsequent sections will show, but all indications are that the individual educational and research activities are becoming increasingly interdependent and any major decentralization would produce insuperable problems. Even the School of Architecture, which was easily left to itself 40 years ago, can not be put some place else because of its close liason with other fields such as engineering, physics, and economics.

It is felt, therefore, that by 1970, 1,500-2,000 more students will be the limit for the capacity of the present site with expansion where possible, with some decentralization, and with continuation of the present trends in educational objectives and in the surrounding Cambridge environment. If, of course, the trends change radically, our prediction can go astray....This prediction does not seem to be out of line with current thinking around the Institute.

Relative Growth

Undergrads:

Enrollment for the fall term of 1955 was as follows:

Freshmen	950
Sophomores	950
Juniors	825
Seniors	910
	3635

At the moment the freshmen physics and chemistry labs place a limit on numbers because they can not hold more than 950 men each. If we assume that the admissions office continues to enroll 950 a class, (assuming also that drop-outs in the last two years will be replaced by transfers from other schools), the enrollment in 1960 will be:

3800 or an increase of 165 over 1955

Given the preceding discussion, we can not assume a sizable added increase by 1970, but some growth can be expected. Therefore, let us assume a top limit of 1,000 per class by 1970, or an undergraduate body of 4,000. This would represent a 9 percent growth over 1955, compared with an increase of 67 percent between 1940 and 1955.

Graduates

Major expansion should be among graduate students. Under the existing departmental quota system, the graduate school as a whole can take another 100 full-time students or about 50 full-time and 75-100 part time.* If a total increase of 400-500 by 1960 seems reasonable, we might expect the number of advanced students to grow by 250-350 or 13-18 percent. During a 15-year period, graduate enrollment might grow by between 1150-1650 or 55-80 percent more than in 1955. This would compare with a 290 percent increase during the last 15 years. (The 1970 total would be 3150-3650.)

WHAT DOES THIS INCREASE MEAN IN TERMS OF PERSONNEL?

Faculty:

Any past growth in the student body has always been accompanied by employment of more professors. What would a growth of 400-500 by 1960 and 1,500-2,000 by 1970 mean in terms of increased professorial staff?

Since the war the ratio of total students to faculty members has grown smaller to approximate what it was during the Thirties, i.e. between 10.5-12.0 students/man. If this relationship is to continue, we might expect an increase in faculty of:

30-40 by 1960
125-190 by 1970

This last would represent a 24-37% increase over 1954, compared with an 87% increase during the period 1938-54.

---

* Some departments are oversubscribed, however, while others are undersubscribed.

Other personnel: office and maintenance; (excluding DIC-DDL)

According to the personnel office, the Institute employs about 1600 weekly and monthly payroll people---just about one for every three and one-half students. We might assume that the number of secretaries, messengers, clerks, etc. will grow along with the student body--but probably not at the same rate as now. Automated data-processing equipment will undoubtedly take the place of some clerical personnel. If we take 1 to 4 as the rate of increase, we can expect few more before 1960 but a total group of about 1800-1900 by 1970, or an increase of

200 (13%) - 300 (19%)

Administrative:

It has been difficult to determine the numerical relationship between administrative--i.e. non-faculty officers--and faculty members and students. We might assume that about half of the 1067 faculty and administrative people tabulated for the residential distribution map in Chapter III were faculty members, and perhaps another 100 or so were on special appointments, leaving an administrative staff of about 400. It might not be unreasonable, however, to suppose that one administrative officer will be added for very 3-4 faculty appointments...or

10 by 1960

40-50 by 1970

DIC and DDL.

The personnel office says that about 1600 people are on DIC staff and hourly appointments. Comparable DDL figures were not obtained. DIC and DDL officials do not expect demands to increase greatly over the next few years. Even if they do,

the added graduate students will undoubtedly be able to fill most personnel needs. Teaching opportunities may become greater as the undergraduate body requires more section men, but they will not grow relative to the graduate enrollment. Therefore, perhaps proportionately more graduate students will be "learning by doing" in DIC or other research projects by 1970 than today.

OFFICE SPACE REQUIREMENTS

These personnel projection figures have been presented as a basis for estimating future office space needs. If we allow for machines, partitions, hallways, etc., we might accept a figure of 250 ft^2/@person as reasonable for faculty and administrative officers, and 125 ft^2/ person for clerical and maintenance staff.

Table 18

Estimated new office requirements 1955-1970

category	no. inc.'55-'70	additional floor space required	
administration	40-50	10,000	12,500
office and maint.	200-300	25,000	37,500
faculty	125-190	31,000	46,500
	365-540	66,000 ft^2	96,500 ft^2

@While these index figures may be considered somewhat large, they were chosen to allow for some expansion in presently-cramped office quarters.

PROGRAM DEVELOPMENT AND ACADEMIC AND RESEARCH PLANT REQUIREMENTS

New enrollment does not just mean expansion of existing facilities. The last 15 years have clearly indicated that time

and events bring new ideas into technical education and research, put new and different requirements on the building spaces used for academic activities. Certain changes in MIT's objectives, which Chapter I indicated are now appearing, will also influence the character of future space needs.

What can we expect, therefore, that an enrollment of 7150-7650 might require in addition to what already exists? The discussion might be divided into three parts.

1. The undergraduate program
2. The graduate and research programs.
3. Non-academic activities within the academic plant

1. The Undergraduate Program

The increasing emphasis on basic science and a 9 percent growth in undergraduate enrollment might require two sets of basic changes within the plant.

A. Classroom and lab facilities: We might expect a need for more large classrooms and laboratories and a greater utilization of the smaller classroom facilities. Right now, only first-year students take the large required chemistry and physics classes. If mandatory higher-level courses are to be developed in these fields, we might expect a greater demand for large classroom space among second-and third-year students. It is also not inconceivable that one or two courses in engineering principles will be developed for all students regardless of their field of concentration.

Therefore, perhaps 2-3 more large lecture halls the size of the one now being built in the Compton Lab may be necessary.

Need for larger laboratory facilities would follow along with classrooms. Physics and Chemistry will have to expand

their freshmen labs in any case, and perhaps 2-3 additional large laboratories will be required.

But the Institute is also trying to make its educational experience more personal and individual...something at which large lectures and laboratories are notably ineffective. No doubt, an emphasis on small section meetings for discussions or practice work would follow from the development of large required courses....perhaps one large lecture a week and two small sections or laboratories, or some combination of the three. The small-class procedure will be aided by the increase in graduate students, since more potential teaching assistants would be available.

Except for the new large-size lecture rooms, these developments would produce little strain on the existing classroom stock. Because present capacity in the smaller room is underused.

Then too, a new student activities center with meeting rooms will cut down the non-classroom use of classroom facilities, leaving more unused capacity in the afternoon hours which could be given over to sections.

Unfortunately, we have no exact figures on the present use of undergraduate teaching labs. Two or three new large laboratories might be required, but they could perhaps be effected by combining smaller facilities. If any other strains develop, some research activities (see p 128) could be transferred outside the main complex to make way for teaching labs.

B. We might also see a significant change in the functions and facilities of the math, physics, and chemistry departments.

In addition to being fields in themselves with substantial numbers of concentrators, they will also develop greater roles as "service" departments for undergrads, similar to, but perhaps more important than humanities, music, languages, and the other purely service departments.

To some degree the three departments already play this dual role with their required first-year programs. But if second, third, and possibly fourth-year courses in the basic sciences become required, the service function will grow, and math, physics, and chemistry will need space not only for their own research and teaching but for these broader activities as well. Right now the three are crowded together in buildings 2, 6, and 8. Present needs require expansion. Future needs may require relocation of one or two of these departments in another building allowing the remaining one or two to expand where they are.

2. Graduate and Research Demands

MIT's objectives commit it to maintaining standards of excellence in areas it has already developed and to developing new programs around areas which its staff and resources are best equipped to handle. The past 15 years offer many clear illustrations of the latter course in both graduate and research programs. A School of Industrial Management, a Phd. program in Nuclear Science and Engineering, the Research Laboratory of Electronics, and other programs were unknown here in 1940. In the future, we can expect both the expansion of existing programs--which will require facilities close to where their work is now being carried on or removal to other locations--

and the development of completely new programs--which will require separate facilities in the same way that the Metals Processing lab and others got special quarters.

Can development come across the board, or shall it be selective? Obviously the last course is the only sound one. The Dean of one of the Schools told this writer that demands were so great that MIT could easily hike its support of all fields and find little difficulty in attracting students.

"The future implies steady expansion," he said, "but not all ventures can be equally important. It is difficult to encourage creative activity, and then hold it back, but when education becomes a mass process it is a frightening thing. There is absolutely no parallel with industrial enterprises in which economies of scale are all-important."

Any predictions here are pure speculation, but electrical engineering, metallurgy, nuclear science and engineering, and architecture and planning seem to be the fields where national requirements are growing the fastest and where the Institute's interdisciplinary approach is best suited to expansion. The seven fields mentioned are hardly the only ones where growth is possible. Physics, chemistry, food technology, biology might also increase both in graduate enrollment and research effort, and so might almost any other. But, these seven seem to be the ones where the Institute itself can best meet growing professional demands due to the orientation and caliber of its staff.

In addition, we can expect a growth in the Center for Advanced Studies and more interdepartmental specialized research

programs--say, between architecture, civil engineering, and physics...or between metallurgy and physics. Actually, the opportunities are infinite, and MIT will have to be very careful in choosing the kinds of interdepartmental research it wants to emphasize at no cost to the educational program. Probably many of these research activities can be located outside the main complex in facilities separate from the departments which sponsor them, as the RLE has demonstrated.

Completely new graduate degree programs are also very likely. To indicate what might develop, we can disuuss two possibilities, a medical school and a department of scientific education.

A. The extreme shortage of physicians and of facilities for training them, is common knowledge. MIT not only has a solid core of biology and chemistry around which to base medical training, but it also has an opportunity to develop a unique type of medical teacher.

For many years the Institute has worked with local medical schools and hospitals in developing new technical equipment.... for instance, "Over the past seven years some 1500 cancer patients have been treated here (with generally good results) in a campus clinic. The X-ray therapy program uses techniques and apparatus developed by EE's John G. Trump...."(MIT Observer, March,1956)

Proponents of medical training for MIT suggest that it might start out as a 2 year Master's program with 50-100 students. After the two years they could transfer to other schools for clinical work, or continue here for advanced degrees

in biology, food technology, etc., with an emphasis on teaching and research.

It is interesting to note that the idea of a medical school at MIT is not a new one. In 1942 a visiting committee recommended that:

> ".....The Institute's most effective contribution to public health can be made in the fields of biological engineering and food technology and ... the training of public health officers and professional workers can best be carried on in an educational environment which encompasses a school of medicine and other allied services."
> (1942 Pres. Rept., p 20)

Such a program would mean faculty appointments in anatomy, but probably few in the other basic fields, since the existing staff of several departments could participate. Here would be another example of integrating disciplines to work on specific cross-disciplinary problems. The need is great, and at present there is a bill before Congress to authorize government financing of half the cost of new medical teaching facilities.

B. "If we are to make headway in education, more teachers of science and in improving the teaching of science, the schools of science and engineering must do more than they have so far done to help in encouraging and preparing more of their students to go into secondary school teaching."
(1955 Pres. Rept., p 7)

If the present rate continues, Dr. Killian added, within the next 5-6 years we will train only half as many teachers as we will need to stay where we are.

At the moment the Institute and Harvard are operating a 5-year cooperative program for science teachers. It is very conceivable that the undergraduate part of the program will be emphasized more strongly and an attempt made to attract more women to it as a way of giving girls more status within the MIT community. (See section on women's housing, p142).

> "...We need to encourage more able women to major in science and mathematics, particularly women who are willing then to become science or mathematics teachers in secondary schools." (14, p 147)

MIT might also want to formalize a special graduate program of its own, allowing a candidate to concentrate in one of the special fields within the Institute, while at the same time providing work in teaching either here or at Harvard. This program might be a special division which could call into play the resources of several departments. Certainly the need is there, and it is a need on whose satisfaction hangs the future of American science.

- - - - -

Of course other new programs may be considered, but these two are presented as areas in which national demand is immense and MIT's resources particularly qualified to lend assistance.

- - - - -

Classified Research: The floor space recommendations below are framed with the premise that classified research will make no more major demands on the Cambaridge plant...except in the case of a national emergency. Since MIT wants to segregate these projects and to use as few of its own personnel as possible except in supervisory capacities, we might assme that future projects of any size can be carried on at Lincoln Lab where there is sizable acreage for expansion, on Cape Cod, or in other areas where the Institute has or can acquire holdings. It is also possible that the Instrumentation lab, despite a proposed $300,000 remodeling job, might move elsewhere, leaving its space here to non-classified projects.

DIC: The writer believes that there will be no major reduction in DIC work and therefore no reduction in space requirements. Since officials feel DIC activities are leveling off, it is assumed in the computations that any increased work can be accommodated within the existing plant and buildings required by increased enrollment and new programs. Since DIC research employs substantial numbers of graduate students and has direct bearing on the teaching process, it should not be split off from other activities except where it might cause undue interference.

3. Non-academic requirements:

Whatever academic plant expansion might occur to meet these requirements will undoubtedly include lounge facilities and will be of such a scale to allow facilities to be installed in areas where they are now lacking. One of MIT's objectives is to "humanize" its working environment, and there is widespread recognition that coldness and impersonality can be measureably reduced by providing well-equipped informal spaces for students and staff. Some such spaces have been provided already (viz.) in Buildings 52 and 31). It is imperative that there be more, especially within the main academic complex. Space pressures become more acute with the addition of each new building, but this is one demand on which there should be no skimping.

Here are some predictions as to the additional floor space required by the academic plant between 1955-1970.

> "In 1940, with 3,100 students, we had 350 square feet of permanent instructional space per student. In 1953, we have 348, thus our new building has just kept pace with our increase in enrollment."(1953 Pres.Rept. p 20)

Table 19--Estimated Space Requirements

We will adopt the figure of 350 ft^2/student as our index*.

A. Expected enrollment increase 1953-1960 = 870-970.			
floor space required =	304,000	---	339,000 ft^2
minus Compton Lab	-135,000		-135,000
Estimated additional need for 1960	=169,000	---	204,000 ft sq.
plus office space need	16,000#		19,500#
ESTIMATED ACADEMIC + OFFICE ADDITIONS NEEDED FOR 1960	=185,000	---	223,500
B. Expected enrollment increase 1960-1970 = 1100-1500			
floor space required	=385,000	---	525,000 ft^2
plus office space need	50,000		77,000
ESTIMATED ACADEMIC + OFFICE ADDITIONS NEEDED 1960-70	435,000		602,000 ft^2
C. TOTAL EXPANSION REQUIREMENTS FOR ACADEMIC PLANT AND OFFICES BY 1970	620,000	---	825,000 ft^2

*The figure of 350 ft^2 in the President's report included offices. For the projection, 350 ft^2 did not include offices, since it was assumed that instructional space per student would have to be larger in the future if a more extensive system of lounge facilities is to be provided and if departments are to be aided whose expansion needs are based not on students, but on existing, cramped facilities. This index does include labs and classrooms. Since the latter are more than adequate for present enrollment, it is expected that future construction would emphasize the former.

#Taken as a percentage of Table 18

HOUSING AND COMMUNITY FACILITIES

The question of how to develop a cohesive, identified community inside the technocratic giant that is MIT is perhaps the most significant one confronting the Institute. Two considerations seem important.

a. How to develop such a community from the students and faculty now at the Institute.

b. How to retain such a community as the Institute grows in size, if it does.

It seems obvious, however, that the existing situation will not stay stable while a community develops, and that the administration will have to exert its efforts towards creating "identification" in a fluid, expanding framework. Thus, the task is all the more difficult.

How many students should be housed,where, and in what t ype of accommodations have been considered such impprtant problems that the Corporation appointed a special committee to make a thorough investigation. After a year of intensive effort, the Ryer Committee has submitted its recommendations.

Since the purpose of this section of Chapter IV is to deal with the quantitative problems of expansion, the Committee's recommendations, programmed on a 5-6 year basis will be examined in the light of the 15-year population projection and the objectives of MIT as discussed in Chapter I. The matter of where to locate housing expansion is also thoroughly important, as is the problem of what character this expansion should assume. These will be treated largely in Section II where the different quantitative needs are drawn together and evaluated.

Undergraduate housing

In planning for the coming 5-6 years the Ryer Committee recommended two new 200-man dormitories. With the remodeling of Baker and Burton and with the transfer of East Campus residents to the Graduate House (a net loss of 170 spaces) which would also be remodeled, total undergraduate dormitory capacity would increase by 40-50 beds.

Assuming, for the moment, that these dorms will be built and that no others will be constructed over the next 15 years--let us examine the proposed undergraduate housing arrangement in the light of enrollment predicted for 1960 (3800) and for 1970 (4,000).

I.

A. Enrollment increase 1955-60 = 165

B. Present percent of enrollment that commutes from homes within the Boston Metropolitan Area (true commuters) = 11%. Assume that 9% of the enrollment increase '55-60 will be commuters from Boston.

No. of commuters in the increase = 15

C. Present percentage of married students in undergraduate school = 4.25%. Assume that 5% of the enrollment increase '55-'60 will be married.

No. of married undergrads in the increase = 9

D. Present percentage of women undergraduates = 1.9%
Assume that 5% of the increase '55-'60 will be women.

No. of women in the increase = 9

E. Assume that fraternity housing remains at the same level (1000)

No. of fraternity residents in the increase = 0

F. Therefore, the total number of male, single undergraduates eligible for Institute housing will increase by about 130 by 1960.

G. Since the Ryer Committee estimates that 500 single undergrads live in off-campus accommodations (See also p 88), and since the two recommended dorms will absorb 40-50 additional men, the total number of "independent" men by 1960 will be

560-570 or 15 percent of the undergraduate body.

Using the same procedure but somewhat different percentages below is a set of calculations for 1970.

II.

A. Enrollment increase 1955-1970 = 365

B. Assume 5% of the total increase comes from commuters in the Boston Metropolitan Area.

Total commuters in increase '55-'70 =18

C. Assume 6% of the total increase will be from married students.

Total married students in increase '55-'70 = 22

D. Assume 8% of the total increase will be women.

Total women students in increase '55-'70 = 29

E. Assume that fraternity housing remains at 1,000

Total number housed in fraternities from increase = 0

F. Therefore, the total number of male single undergrads eligible for Institute housing in the increase will equal about 300.

G. The total number of "independents" in the undergraduate body will be (accepting the Ryer Committee's recommendations as final) 750-60 or 19% of the student body.

(Note: the percentage of married students might be more and of women students less, depending on Institute policy, but any difference would probably balance out.)

- - -

If the Institute is to house the same proportion of undergraduates in 1970 as it would in 1960 under the Ryer Committee's recommendations (42.5%), accommodations for an additional 100 men would have to be provided. The main question seems to be, however, whether MIT should think of housing proportionately more or fewer undergraduates in 1970 than recommended by the Ryer report for 1960. Or, stated a different way, are two new dormitories sufficient if MIT is to achieve its goal of becoming a residential college?

The writer does not think so, and the following discussion will attempt to show why.

- - -

MIT follows two policies which will be in conflict with a residential college idea, policies which the writer feels must be amended if a residential college is to succeed.

1. The Institue does not believe in making on-campus residence compulsory for men above the freshman year. Freshmen who do not come from Boston, live in fraternities, or live with relatives must live in a dormitory.

2. The Institute believes in the dual value of a waiting-list.

   a. It enhances the value of a dormitory room.

   b. It acts as a check on infractions of rules within a dormitory, since potential offenders realize they can be turned out and that other men will be easily found to take over their

rooms. (See quote on p 57)

Even if the Ryer Committee's recommendations are enacted, a waiting list of 100 will remain. If the dormitory system does prove appealing, we might expect this 100 to increase.

- - -

In dealing with the second policy first, the writer believes it should be completely eliminated. Just so long as a scarcity of rooms continues, a waiting list will be necessary, but it should not be regarded as having any disciplinary impact on dormitory residents or any tantalization effect on non-residents. Whether these effects hold true now is even questionable. At any rate, the policy itself is a negative one and hardly forward-looking. An objective of creating a residential college is forward-looking and should not be hampered by thinking framed during a period when the Institute possessed no developed policy towards integrating an extensive dormitory system with its educational program and when there were no faculty residents to take a hand--albeit indirect--in dormitory discipline. Students should want to be members of a dormitory because it possesses positive advantages, not because its advantages are unwarrantedly magnified by holding them at bay.

- - -

A number of factors lead the writer to believe that the Institute should consider modifying--but by no means eliminating- its desire to make on-campus living a matter of individual choice.

The Ryer Committee felt, and rightly so, that any idea of providing accommodations for all eligible students should wait until the system proved itself. Since so much attention is being devoted to improving the residential system--in spirit as well as in facilities--the writer has no doubt that it will prove its success in a relatively short period of time.

In that case--what will be the significance for those "independents" who are not members of the dormitory or fraternity system, either through the scarcity of accommodations or through their own volition?

Perhaps we can come to some conclusions by balancing the advantages of dormitory residence now against off-campus residence now and doing the same for the system as envisaged by the Ryer Committee.

Of course, the main advantages of dormitory living are its proximity to the academic plant and to athletic and other recreational facilities and the presence of other students in the living environment. It has a definite cost advantage when compared with accommodations whose distance from the Institute requires an outlay for transportation. (See P 96) There is a greater sense of " commuhity" than a decade ago, but, as the Ryer Committee demonstrated, much is still to be desired. The dorms are too large and impersonal. There are not enough lounge facilities, and faculty-student contact is still insufficient. Student self-government does, however, give an opportunity for organizational participation which

does not exist on the outside.

Off-campus lodings are farther away and often more expensive, but they do hold the advantages of isolation and freedom for the men who desire. Because no strongly-developed faculty resident system exists within the dorms to make them the seat of wide faculty-student contact and because the dormitory "community" is still somewhat loose and impersonal, there is not too great a disparity between the kind of living offered in the dormitories and the kind of living to be found off-campus. Each has its different qualities and defects, but, while the waiting list indicates an unfilled desire for campus residence, an off-campus student does not miss too much....at the moment.

Under the system as proposed by the Ryer Committee, the writer believes that a significant disparity can result, that off-campus residents may wind up as have-nots against the dormitory members' haves. There will be two more new buildings in addition to Baker House. The units will all be smaller, more personal, better equipped with lounge, kitchen and dining facilities. If the Baker House experience proves fruitful, mealtime might develop into a more plesant, leisurely, more human experience than a run-through from a cafeteria plate. Even if there is no more than one faculty resident per unit, the ratio will be one man to 2-300 students instead of one to 350-600. But all indications seem to be in the direction of more than one faculty resident per unit, or perhaps one faculty member and a few graduate students. The next few years will see a radical transformation of dormitory living

towards a true residential college. Off-campus students will be denied advantages which neither they nor the dorm members possess now, but which the latter will soon have.

Now the argument will always be levied that these small, compact, tightly-knit units may produce an unpleasant degree of conformity, may demand mediocrity, and may limit personal freedom and choice....thus allowing "independents" to conduct their college careers free of these stultifying restraints. Of course, these are dangers, real ones, not to be denied. But they do not necessarily follow from the system if the system is handled well. The writer has faith that the Institute will draw on the lessons of past experience, its own and those of other schools--to see that the dangers are avoided.

Before coming to MIT the writer was fortunate to have pursued his higher education at two institutions which represent the polar opposites of philosophy towards a residential system....one, a large American university where all students except "true commuters" are required to live on campus in university housing and where there are no fraternities...the other, a European university whose students come from all over the nation but whose policy is to provide no housing at all. Each type has advantages and disadvantages to be sure...but they both possess an attribute which MIT would not have it it were to develop a real residential college for only part of its undergraduate body exclusive of fraternities. All students at Harvard and at the University of Amsterdam are

in the same boat. While they are all subject to the defects of the system which operates within each institution, the institution supplies no more advantages to one segment of the population than to another.

In order to avoid creation of haves and have-nots in the future, the writer makes the following suggestions which will have direct bearing on the size of the dormitory system.

1. Require on-campus living for freshmen and for sophomores who do not live in Boston or in fraternities.* The freshman year is one of many changes and revelations. A boy has left the associations of home and childhood and is suddenly confronted with the magnitude of the world of ideas and technology...and the adjustment which follows is often difficult and can not be effected in a short time. Also, he is on his own in the society of his peers and professors. The freshman year is one of adjustment and foundation-building. While the small-group living of a dormitory with its educational associations is extremely helpful in the adjustment process, the writer does not believe that the freshman year provides a true test of the benefits that a dormitory can produce for the man or of the contributions the man can make to it. One additional year, in which the person is perhaps more settled, more able to take responsibility within the dormitory, more at a point where his own ideas are developed,

---

*Logical extensions might be to eliminate someday first-year fraternity residence and also require on-campus living for Boston freshmen. These are matters of staging, however, and the several recommendations here are considered sufficient for a 15-year program.

should be required. If, after the sophomore year, a man no longer wishes to remain on campus, he should be given free choice to live outside. This system would have the following advantages:

1. It would be a better test of the effectiveness of a residential college system.
2. It would eliminate any disparity that might exist between on-campus and off-campus accommodations, since the student would then have had a full opportunity to assess their advantages or disadvantages.

We can look at this another way. Although, as Alonso pointed out, there seems to be no shortage of outside rooms at the present time, within the next 15 years the Institute might expect a large influx of graduate students for whom it does not have so strong a commitment to provide housing. Other nearby institutions too, like Harvard and B.U., may also expect enrollment increases, and there is a real possibility that the stock of rooms in Cambridge-Central Boston will not increase commensurate with the demand. We can therefore look at off-campus undergraduate rooms in terms of their replacement value as graduate student accommodations. If more undergraduates are brought to the Campus over the next 15 years (and they can be housed in accordance with MIT's aims) more rooms will be made available for advanced men on the outside.

The writer is not advocating compulsory sophomore residence as an immediate step. The Ryer Committee justly felt that required residence of any kind should not come until the new system began to prove itself. Rather, the policy is

suggested for sometime soon after the new system has begun to operate, i.e. within the next 5-7 years.

2. The Institute should make on-campus residence easier for commuters than it now is. Although the SEC's recommendation of compulsory on-campus residence for freshmen from the Boston Metropolitan Area (to be financed in cases of special need from a fund collected within the BMA), has much merit... the most immediate problem seems to be one of providing living arrangements for men from out-of-town. Once MIT is satisfied that this has been accomplished, a full-fledged commuter-resident program can be considered. Some kind of special loan assistance for Boston freshmen who would like to live on-campus might prove profitable. The section on facilities below will discuss the problem of commuter integration in more detail.

3. The Institute should renew its offer to provide fraternity buildings on campus. Land and financial pressures are such that MIT can not afford to build small, separate fraternity facilities, however, and combined dormitory-type buildings seem the only solution. The fraternities rejected this solution a few years ago, and there is no indication that they will not reject it again. How to integrate fraternities will always prove a problem so long as most of them are across the river, but, no matter how thorny a problem it may prove to be, the Administration's first thought must be towards men who do not live in administration-sponsored living units. Since the number of these men is large and since dormitory provision must compete with other needs, the writer feels

that, even if the offer is renewed, there can probably be no change in the fraternity arrangement before 1970.

4. The Administration should increase its women students to a point where they become a meaningful--albeit small--part of the Institute family and where the desire to adopt a residential system for them becomes an integral part of MIT's objectives. At the moment, they are the have-nots among the haves. If the undergraduate women were increased to at least 100 and if pleasant dormitory facilities on campus were provided for from 50-75 or more, including graduate students, it would do much to reduce the present inequities.

The only other solution which appears to the writer is for the Institute to refuse to accept any more women undergraduates. One hundred girls would be able to participate not only in general extra-curricular activities, but also in their own clubs, intra-mural sports, etc., and a dormitory would provide them with more "gracious living" than they enjoy now.

How many should be housed?

With the above suggestions in mind, let us see what the additional dormitory requirements for single undergraduates might be for 1970. (Married undergraduates will be treated with married graduate students.)

A. Total number of "independents" exclusive of women and married students by 1970 = 750-60

B. Expected number of sophomores among these = 250

C. If the waiting list stays at 100, we might expect 66 to come from the top two classes.

D. Total number of "independents" eligible for or desirable of accommodations in 1970 = 315 approx.

If the residential system does prove successful, the chances are that more upperclassmen and more Boston Metropolitan Area students will want to enter it, and the total of D above might rise as high as 400-450.

1. This would justify construction of two additional dorms of 200-and 250-man capacities between 1960-70. From 300-350 men would still live off campus.
2. On-campus dormitory space for from 50-100 women students should be provided.

Area requirements: As a space index, the figure of 400 ft^2 per student (gross) was adopted. This is slightly less than Baker house would provide if remodeled under the Ryer Committee's proposals (405) and would include dining and lounge space. The high figure below expands this somewhat to cover the possibility of more faculty residents.

Table 20

Undergrad Dormitory need by 1970-(including Ryer Committee's Recommendations, 2 Dorms)

4 men's dormitories 200 men each (one at 250) 80-85,000 ft^2 each

	Low total	High total
	320,000ft^2	360,000
Women's accommodations 50-100	20,000ft^2	40,000
Total undergrad (+grad women)	340,000	-- 400,000 ft^2

Graduate Student Housing

The Institute has no strong commitment to house a major proportion of its graduate students. Its objective is twofold...To develop some substantial living accommodations on campus commensurate with graduate students' needs...To develop a graduate community spirit and some sense of identification with the Institute through programs within the dormitories and a graduate center. Since we expect a graduate student increase 4-5 times that of college growth, we do, however, envisage the need for new buildings.

The following procedure will attempt to estimate the number of graduate students to be housed by 1970.

A. Number of single graduate students, 1955 = 1500 approx.
   Number of single grad students housed on campus = 450 = 30%

B. Total number of single grad students desiring housing on campus in 1955 = 625 = 41.5%

C. Estimated total number of graduate students in 1970 = 3150-3650

D. Percentage of married graduate students in 1955 = 25%
   Estimated pct. of married grad students in 1970 = 30-35%

E. Estimated number of single graduate students in 1970:
   For a population of 3150 = 2000-2200
   For a population of 3650 = 2350-2500
   Estimated single grad students in 1970 = 2000-2500

F. If the Institute is to house the same proportion of single graduate students in 1970 as now (30%), it will house:
   615-750 men

G. If MIT is to house a proportion comparable with those requesting dormitory space (41.5%), it will house:

850-1050

Estimating actual construction needs for graduate student housing will be very difficult, since there seems to be some question as to whether or not the existing East Campus complex with Walker as a graduate center should be used--as recommended by the Ryer Committee. This is a highly important locational problem which wi ll be treated in Section II.

A. If East Campus is to be used (capacity 600 with remodeling), the Institute will have to provide additional accommodations for from 15-450 men (see F and G above).

B. If other accommodations are to be provided, it will mean rooms for 615-1050.

Translated in terms of ft^2 areas/man--A would mean construction of from 6,000-180,000 additional square feet of floor space. B would mean 266,000 to 445,000 square feet.

Range of floor space demanded for 1970 =

6,000-445,000 ft^2

(Note: index for A was 400 ft^2/man. In computing B the figure of 425 ft^2/ man was used, since new construction in another area of the campus would undoubtedly mean building a graduate center with meeting rooms in addition to dining facilities.)

Determination of the merits of these alternatives will have to wait until Section II

Married Student Housing

Assessment of the possible alternatives here is extremely difficult. As the Ryer Committee pointed out, and as the Administration and every resident family knows, the barracks can not last much longer. Any estimate of future needs will have to consider them as eliminated. While MIT has made certain policy commitments to house married students, it has not made a commitment to house any particular number or percentage. Nor is there any special desire to establish facilities for married students other than housing...i.e. a separate social center. While the Institute wants to integrate them with the MIT community, there does not seem to be much of a wish to 'over-subsidize' students' families. The main feeling seems to be that accommodations should be provided for those who can not afford them elsewhere.

Based on our projected enrollments and projected percentages of married students, how many altogether might there be in 1970?

A. We assume that 30-35% of the graduate students would be married, and that about 5% of the undergraduates would be married.

B. Estimated total number of married students for an enrollment of 7150 = 1145-1335

C. Estimated total number of married students for an enrollment of 7650 = 1360-1510

D. Number of married students housed on campus in 1955 = 280 = 42%

Total number of married students seeking accommodations in 1955 = 550 = 84.5%

E. If the Institute were to house the same percentage of married students in 1970 as it does in 1955, it would house from 480-675 families.

F. If the Institute were to house 84.5% of the married students, it would house 965-1275 families.

G. Since 84.5% would be proportionately larger than for either single undergraduates or graduates, and since there is no policy commitment to house any major percentage of married students, the writer feels that 55% would be the highest rate MIT might wish to consider, or

630-830 families

H. Comparing E and G above, we might consider 480-630 families as a reasonable figure on which to base area estimates.

I. An estimate of floor space should really consider how many childless families and how many families with children would be accommodated...and this would require detailed study beyond the scope of this thesis.

As a rough guess, we can take an index figure of 800 ft^2/family, substantially larger than that of Westgate or Westgate West, yet substantially smaller than that of Bexley Hall and somewhat smaller than the 870 ft^2.family recommended by the APHA for 2-6 story structures.

For 480-630 families this would mean a floor area of 384,000 - 504,000 ft^2

- - - -

(Note: More faculty housing is needed within Cambridge. It would improve faculty-student relations, would be of great value to the city and of inestimable convenience to the faculty members themselves. Although no detailed financial estimates have been made for this report, certainly such housing would involve a far greater expenditure than married student accommodations. In terms of priorities, too, the latter seems essential...the former, desirable. The writer has not attempted to set up requirements for faculty housing, and it is doubtful whether the Institute could consider devoting a substantial amount of its <u>own</u> resources to the area. Nevertheless, this is a thoroughly important problem deserving further investigation.

If the Urban Renewal program gets under way,(see Section II) the Institute should definitely try to encourage private investment in low-cost housing for both faculty members and graduate students. It is also possible that MIT might want to offer junior faculty members and fellows accommodations within whatever married student complex is developed.)

<u>Other facilities and commuter integration</u>

The Ryer report stresses the need for lounges, kitchens, and dining facilities within the dormitories. A graduate center with dining and meeting space was also recommended. If Walker is not to be used, our figures for new graduate construction above allow space for such a center. A student activities building, programmed for some time and also recommended by the Ryer Committee,seems essential.

Rather than building a separate center for commuters, the writer feels the desired integration with the MIT community can be effected through three means:

1. By expediting on-campus residence through a special loans for that purpose.

2. By assigning undergraduate commuters, especially in their freshman year, as non-resident members of individual dormitories. They would be able to take meals at the dining halls, but, more important, they could become full-fledged participants in the activities of the dormitory. Perhaps they might also be assigned to the faculty resident as advisees.

3. By providing any separate commuter facilities that might be desired--within the student activities center. Here the physical proximity to functions and organizations of the resident students might do much to eliminate feelings of isolation--both real and imagined.

Size of Student Activities Center: This is difficult to estimate. If the suggested site on West Campus were utilized (220'x120') for a three-story structure, it might run to 60-70,000 ft^2.

Shops and stores: There is some question as to whether the Hennessey block should be retained, and if so, whether the stores available will be sufficient. Much depends on the population which will eventually be housed in the present environs of MIT. If it is to be substantially greater than

now, more shopping opportunities should be provided, and some decent restaurants would be able to operate successfully. This, of course, would be a matter for private interests, but MIT would do well to consider attracting new commercial ventures to the area.

ATHLETIC PLANT

The writer claims only to be a participant in, not an expert on, athletic facilities. A recent report by the Athletic Committee made an assessment of area requirements based on an estimated 1965 student population of 7200. Since this figure deviates little from our 1970 projection, we might accept the report as an accurate statement of need. The Committee felt that 1,250,000 ft^2 of usable outdoor area would be required for an effective program, or an addition of 600,000 ft^2 to the present area. The MIT Coaching Staff recommends additional indoor floor space totaling over 100,000 ft^2. These last requirements could be met if the Institute were to construct or acquire a gymnasium facility.

Estimated needs: Land = 600,000 ft^2
Gymnasium = 150,000 ft^2

PARKING

There is no more difficult need to estimate than parking. It completely depends on where new building will be located and on how many new students will be given on-campus accommodations. At this point, however, we can make a rough estimate of the potential parking space that might be demanded on the basis of enrollment and personnel increases. As an index, we will use

320 ft^2/ car.

A. Number of student increase by 1970 = 1500 - 2000

Number of personnel increase by 1970 = 350 550(rounded)

1850 2550

We might assume that one out of every 4 of the above will want to park a car on campus each day...i.e. 460-640. But 500-600 MIT people already park their cars illegally on neighboring streets, so the additional demand might be considered in the range of:

310,000 - 400,000 ft^2--if there is no substantial increase in the percentage of people driving to work. Chances are, however, that more will be driving and the new requirements might be higher...i.e. 600,000 - 700,000 ft^2 (more than double the present size). This is a huge figure. It indicates that the administration might have to consider even more stringent regulations to limit automobile use.

Table 21

Summary Quantitative Projections for M.I.T. Population and Facilities

A. Population:

category	1955 pop.	increase to 1960	increase 1960-70	1970 pop.	% increase	
undergrads	3,635	165	200	4,000	9%*	67%@
grad students	2,000	250- 350	900- 1,300	3,150-3,650	57%-82%*	290%@
TOT. STUDENTS	5,635	400- 500 (app.)	1,100- 1,300	7,150-7,650	27%-35%*	77%@
Faculty	515 ('54)	30- 40	95- 150	640- 700	24%-36%#	87%@#
Office + Maintenance	1,600	50- 60 [a]	150- 250	1,800- 1,900	13%-19%*	
Administration	___	10	30- 40	--	___	_____

Total student increase, 1955-1970 = 1,500-2,000

Total personnel increase, 1955-1970 = 365-540

*...percent increase, 1955-1970

@...percent increase, 1940-1955

@#..percent increase, 1938-1954

#...percent increase, 1954-1970

a...taken as a percentage of Table 18

Table 21, cont.

B. Facilities:

Projected Building Space Needs----1955-1970

category	low estimate (ft^2)	high estimate (ft^2)
Academic Plant (excluding Compton Lab)	620,000	825,000
Housing Accommodations:		
Male undergrads, 4 dorms for, 800-850	320,000	360,000
Space for 50-100 women stud.	20,000	40,000
Accom. for 480-620 married stud.	384,000	504,000
Accom. for 615-1,040 grad. stud. (including grad. center)	6,000*	445,000
Total Housing	730,000	1,349,000
Student Activities Center	60,000	70,000
Gymnasium	100,000	150,000
TOTAL ADDITIONAL FLOOR SPACE	1,510,000 ft^2	2,394,000 ft^2
% increase, 1956-1970 = 43.5%		68.5%

Estimated additional space needed for athletic fields = 600,000 ft^2
% increase = 96.0%

Estimated additional space needed for parking = 310,000-700,000 ft^2
% increase = 57.0%-128.0%

* See discussion, p 145

SECTION II

Location and Character of Development

Assume, for the moment, that the Institute had all the funds and land it wished, with no limitation placed by existing facilities. What type of spatial organization might it wish to consider? Chart x presents a schematic diagram of an "ideal conception".

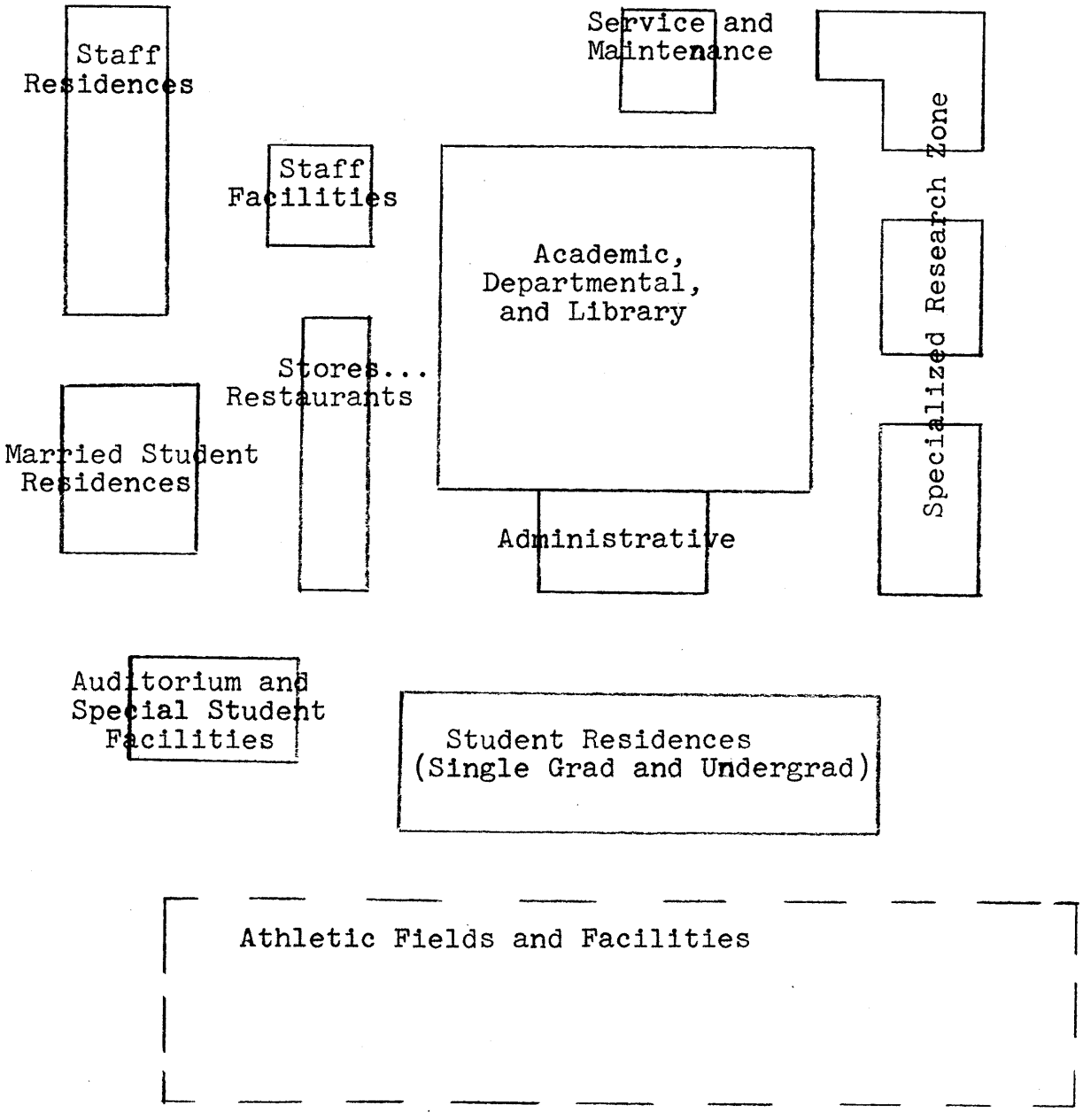
Major academic, departmental, and library facilities are centralized at the hub of the complex. The specialized research activities, i.e. interdepartmental labs, noise or odor-producing projects, projects requiring heavy machinery, etc., locate outside and around the main complex yet in close association with it. Service and maintenance functions are also localized and apart, yet in a key position to minister to the academic and research plant.

Administrative functions are attached to the main group and central to all other activities. Residences for single undergraduates and graduates are also concentrated in one area, close to classes and labs, to special student facilities, and to stores and restaurants. The athletic fields are behind/on the fringe. Staff facilities, i.e. faculty club, meeting rooms, etc., are in between staff residences and the main plant. Married student accommodations are near the family-type staff residential area, yet also close to the auditorium and student center. The stores and restaurants are convenient both to the residential area and to the main plant. Parking space could be provided either on the fringe or in the basement levels of structures.

Chart x

SPATIAL ORGANIZATION OF A TECHNICAL UNIVERSITY

Idealized Concept:



As an ideal scheme, this would possess unity, flexibility, and an effective ordering of uses, each of which could expand without conflicting with another.

How can the Institute satisfy the proposed requirements for 1970 and approximate this ideal scheme? A number of arrangements might be possible, but the following discussion will attempt to set the stage for three alternative plans.

desirable direction of expansion

The land use map showed a thick belt of intensively used industrial land collaring the Institute to the north, west, and east. Along Vassar St. runs the Belt-line system of the B+A Railroad, serving this industrial district. Possibilities are slight that the railroad line, which effectively splits the area apart, will be abandoned during the next 15 years. First, of all, the district is expected to continue under heavy industrial use, and secondly, the track itself is a transfer line for goods between North Station and the southern lines. If the Atlantic Avenue track between North and South Stations should be abandoned, the belt system would have even heavier traffic.

How advisable is it for MIT development to "jump" the railroad and industrial district to some other point in Cambridge?

Academic and Research These activities are growing increasingly interdependent. Whatever new non-classified programs might be developed (excluding inter-university projects like the accelerator) as instructional fields or large-scale research ventures will, no doubt, have to be

located close to existing departments. For such facilities to jump the industrial belt would be inadvisable.

First of all, they would lose communication with the rest of MIT. Secondly, if they can be split off from other activities, they would be more economically located outside of Cambridge where open land is available, where no existing structures are to be demolished, and where the cost is much less...f.i. in Lexington where MIT already has substantial holdings.*

For academic and research activity to spread to West Campus is also inadvisable. Here is the residential and recreational sector of the Institute, and new residential and recreational needs must be accommodated. Encroachment of other uses would be unfortunate and would produce sharper conflicts of site organization than exist at present.

The most desirable direction of plant expansion is towards the East to the Sloan Building and South of Main St. which forms an effective traffic barrier between the Institute area and the rest of Cambridge. Activities would be centralized and Building 52 would no longer be isolated. At the moment, MIT has no holdings in this area where academic or research facilities could be located. The River frontage to the East is occupied by 100 Memorial Drive, National Research, and Godfrey Cabot...new buildings, healthy uses,

---

*We assume that the four buildings now used outside the main area--Whittemore, Barta, Kraft, and Bldg. 80, for special DIC purposes, will remain in operation, but that no others will be inaugurated.

which can not be removed. Expansion in this direction would mean land acquisition, and the three alternative proposals will present possibilities.

Residential facilities. They would have to jump both railroad tracks and industrial belt if construction were to take place outside of West Campus or the Memorial Drive frontage now used by Smith House and Howard Johnson's. Would there by an advantages in the jump? For single undergraduates and graduates there would be no advantage at all. Not only would the walking distance be considerable, but the remoteness from MIT and the scattering of residential facilities this would represent would defeat MIT's wish to develop a sense of "community" among its students. Perhaps such decentralization might have had some value in 1935 or even in 1945, but now it certainly has none.

For married students, housing in a residential section of the city, close to schools and shopping actually would possess many advantages. The Institute hardly expects married students to develop the same sense of "community" as single men; their living patterns, habits, and needs are different and could be well served within a residential area not too far from MIT, where whatever Institute facilities they might want to use would be within relatively easy reach, and where the journey from home to work could be relatively short via MTA or on foot. Faculty housing might meet the same criteria. The alternative proposals will examine location possibilities in the area between MIT and Harvard Square, South to the River.

Flexibility

Any new development should meet flexibility requirements similar to those Professor Lynch suggested for the New England Medical Center:

"...The difficult quality of flexibility must be achieved which allows unpredictable changes to occur with a minimum of disruption. If anything be certain, it is that medical techniques and facilities will continue to change at a rapid rate, and that obsolescence will be an ever-present problem. But flexibility must be gained without hampering present functioning. Such techniques as the use of standardized space in large or tall buildings, which permits fluctuations and reallotments; a master modular grid of levels and distances and directions, which simplifies the joining of structures, or the planning of original units with column capacity to take on additional stories, are all useful. A certain looseness in the original siting, allowing interior growth, and a plan which does not place any major functional group in a location which is completely boxed in by other groups, are equally necessary. Integration of specialized units, and good intercommunication, will in the long run prove the most adaptable pattern." (15,pp 49-50)

The Plans

Plan 1 Would retain East Campus as a graduate center (suggested by the Ryer Committee) and concentrate all new plant construction--aside from possible re-use of sites within the main area- between Ames and Wadsworth Streets. Vassar St. land East of Mass. Ave. would stay in research use. West Campus would become an undergraduate residential area with gym, recreational, and athletic facilities. All married student and faculty housing would locate outside between the Institute and Harvard Square (except for 100 Memorial Drive). New buildings would have parking space at ground level or below, and Vassar St. holdings West of Mass. Ave. would be turned into parking lots.

Plan 2 Would use the East Campus site for additional academic or research facilities (plus underground parking) and still expand eastward, but concentrate on the area directly across Ames St. from East Campus. Walker Memorial would become a faculty club and personnel dining center.

On the west side, Plan 2 shows complete centralization of student residences: undergraduate, graduate, and married. Faculty residences might be located towards Harvard Square, at 100 Memorial Drive, and on the site behind the President's house now used by undergraduate dorms.

Athletic field space would be greatly curtailed in this scheme, and the Institute might be forced to look elsewhere for additional field sites.

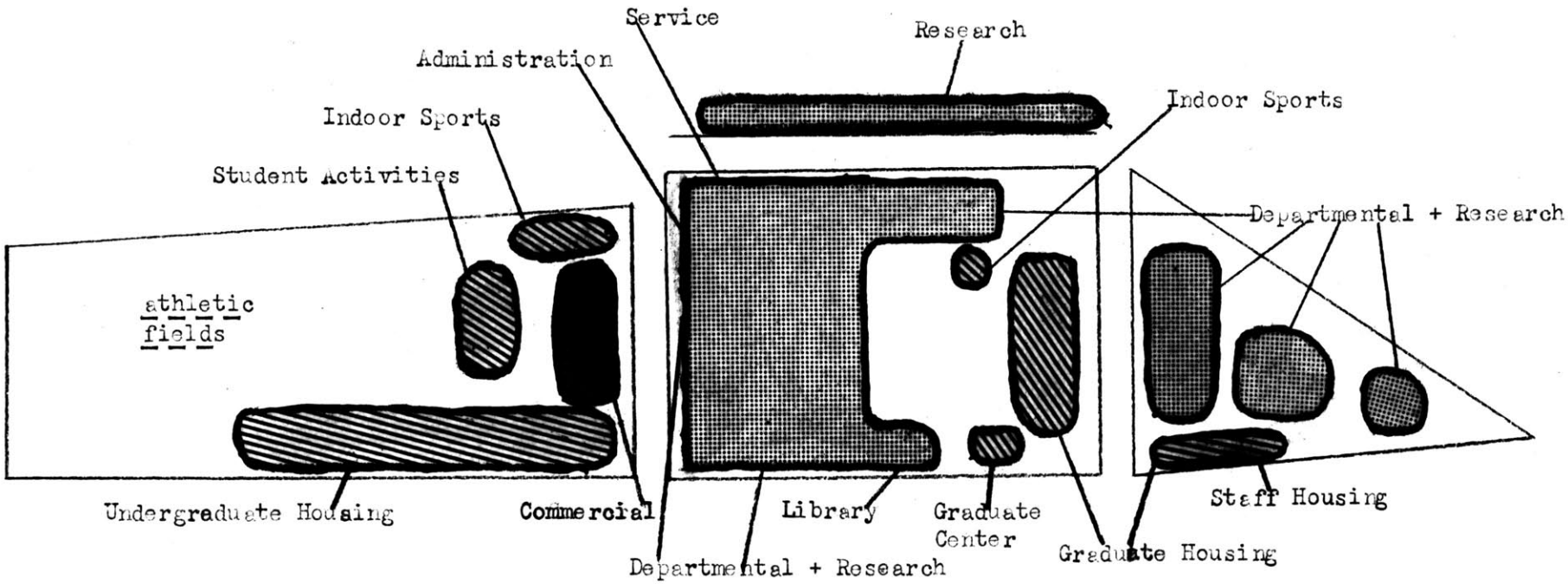
Plan 3 is essentially the same as Plan 2, but does not curtail athletic space and actually allows for expansion into the Westgate, Westgate-West area. West Campus still becomes a center for student residence, but the only married student accommodations provided on a permanent basis come in an apartment facility for couples or people with one child. Permanent family arrangements are made outside towards Harvard Square along with faculty residences.

Discussion

Plan 1 is the least advantageous of the three. It does allow existing dormitory facilities on East Campus to be retained. It does allow for undergraduate residence centralization, and for athletic field expansion. But its basic defects are substantial.

Schematic Proposals for Building Use Relationships at M.I.T.----1970*

PLAN 1



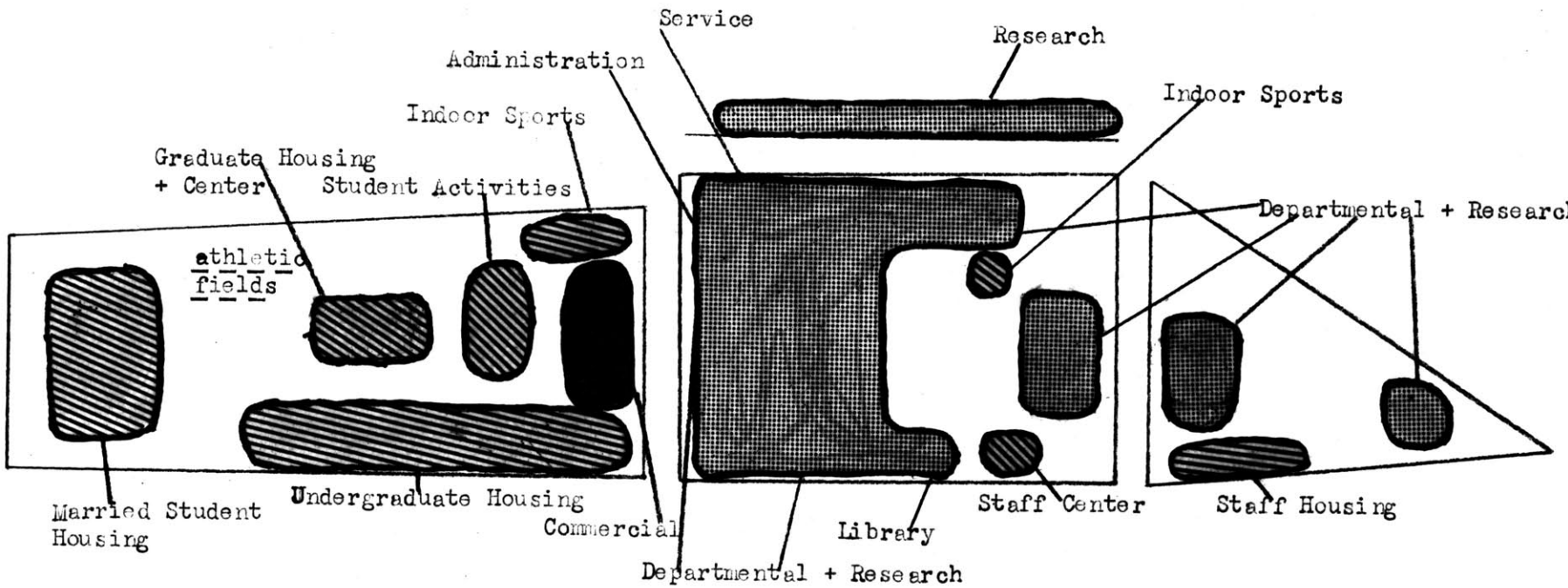
Outside the area: Staff Housing
Married Student Housing
Four Research Buildings
(see text)

Outside Cambridge: Fraternities#
Classified Research

*The forms intend to show relationships between uses, and do not necessarily indicate single structures.
#Except those now on West Campus.

Schematic Proposals for Building Use Relationships at M.I.T.----1970*

PLAN 2



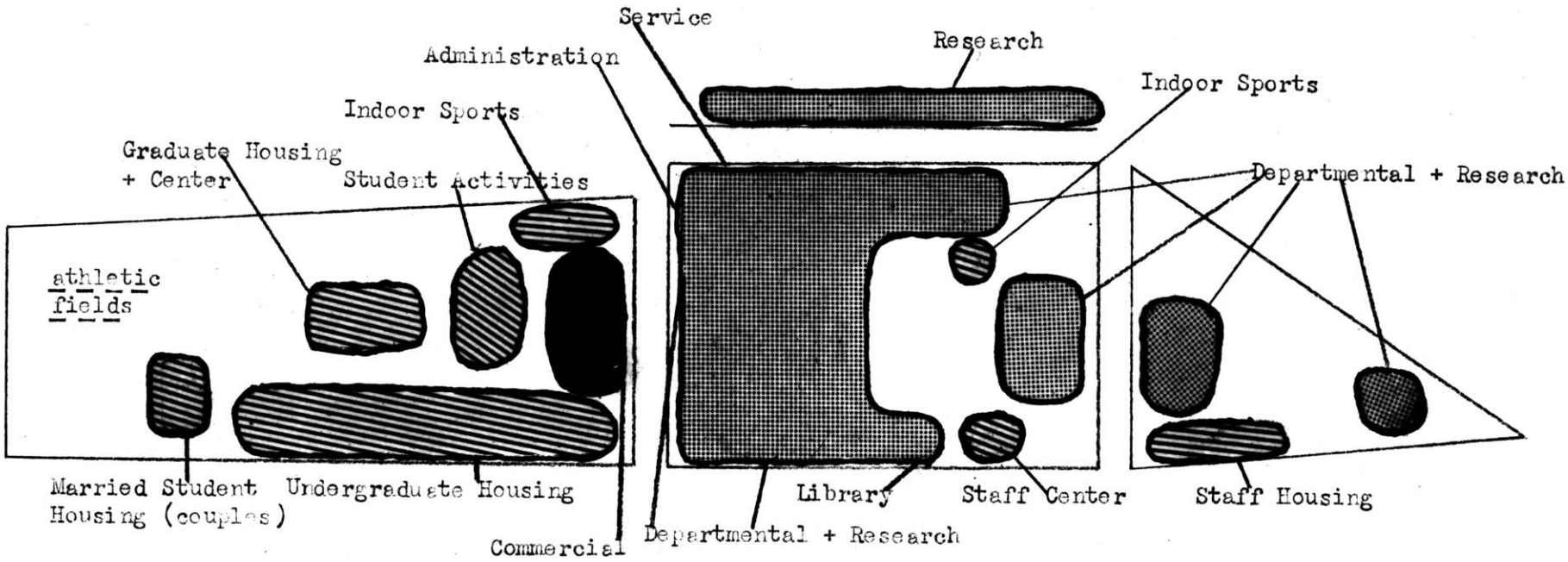
Outside the area: Staff Housing
Four Research Buildings
(see text)

Outside Cambridge: Fraternities#
Classified Research
Athletic Fields

*The forms intend to show relationships between uses, and do not necessarily indicate single structures.
#Except those now on West Campus.

Schematic Proposals for Building Use Relationships at M.I.T.---1970*

PLAN 3



Outside the area: Staff Housing
Married Student Housing (families)
Four Research Buildings (see text)

Outside Cambridge: Fraternities#
Classified Research

*The forms intend to show relationships between uses, and do not necessarily indicate single structures.
#Except those now on West Campus.

A. East Campus as a Graduate Center: In the 5-6 year time perspective of the Ryer Report, East Campus is the only location for a graduate center. It is imperative that undergraduates be moved from the isolation of East Campus to the West, that dormitories be remodeled into smaller, more livable units, and that two other buildings be constructed if the residential college idea is to come into its own. With some renovation, East Campus will accommodate the graduate student demand.

But it will require extensive remodeling and probably a large outlay for new units to meet an increasing demand, if East Campus is to become a true Graduate Center on a permanent basis. The long barracks-like units are unleasant in themselves. With the continuous din of United Carr Fastener in the background and the constant traffic noises of autos using nearby parking lots, the environment of East Campus leaves much to be desired.

Then, too, graduate students might become just like the present residents, isolated from the rest of the MIT community (One can hark back to the fight against isolation that Woodrow Wilson fought and lost when America's first graduate center was established in Princeton). Of course the proximity to classes, libraries, and swimming pool somewhat balances this difficulty.

The chief reason against East Campus as a permanent graduate center is the expansion need of the academic plant. Land pressures are such that MIT is almost forced to take to the air with any new construction. With parking space being

used for building sites, some kind of parking garage system for the main complex seems necessary. If 600,000-800,000 ft^2 of additional floor space is to be built by 1970, if parking is to be provided for additional vehicles, and if East Campus is not to be treated as a barren wasteland where every foot of green space gives way to asphalt or brick, the writer sees no sound alternative to using both the area now devoted to the Alumni Houses and the land which might be acquired nearby for academic plant expansion. What could be done without using the dorm sites?

B. Scarcity of land to the East

There is no open land in this area. Suppose MIT wanted to build a facility similar to the Compton Lab (site area 60,000 ft^2 approx.) Assessments range from \$5-\$10.00/ft^2 and acquisition cost would be at least twice this price. This means a minimum of \$600,000 for acquisition and probably well over \$1,000,000 including site preparations...before the first brick is laid. Chances are that the cost would be even higher, and that assembling adequate-aized parcels would be difficult. The writer refers to Harvard's recent difficulties in assembling enough land for the site of a new House. A few property owners are still holding out, and one wants \$9/ft^2...and this is in a residential section of the city.

Chapter III indicated that it is highly doubtful that many firms would want to leave this area because of its excellent advantages for industry. At the moment, there seems to be only one possibility for land acquisition in the indus-

trial belt--and this is a good one. The writer understands that the Institute is considering purchase of 100,000 ft^2 directly across Ames St. from East Campus...price unknown. This site has tremendous advantages, but can hardly meet most of the estimated plant expansion needs by itself. In liew of any indications to the oontrary, the writer considers that this is the only usable site which might be obtained and cleared within the industrial belt by 1970.

What could be done between Mass. Ave. and Ames St.?

1. A four-story structure could join Building 7 and the Aeronautics lab and provide 36,000 ft^2.

2. An eleven-story building on the site of Building 20, with the first floor and basement used as a parking garage for 250 cars might provide 250,000 ft^2 of usable floor space.

3. A ten-story building connected with the Compton Lab on the site of Building 32, with room for 55 cars in the basement, might provide 126,000 ft^2 of usable space.

A total of 412,000 ft^2 of usable academic or research space would be built, but 213,000 ft^2 would be destroyed, or a net gain of only 200,000 ft^2. With ample garage space, another 250-300,000 ft^2 could be provided on the Ames St. land...but still far below what will be necessary by 1970.

Possibly Buildings 28, 29, 30 could be replaced also, but a solid mass of high structures along Vassar St. and Mass. Ave., enclosing a oourt filled with low buildings is not to be relished. The area would be visually unpleasant and far too congested.

Long-range expansion to the East Campus living area is logical. Neighboring industries would hardly be bothersome. Cars could come directly from Ames St. into a 280 car garage covering the same area now covered by the Alumni Houses. An eight-story building above could provide well over 200,000 ft^2*; and, with more stories, even additional floor space.

The footings in the Alumni Houses are too weak to carry anything greater than the normal dormitory load, so the buildings can not be converted to other uses. In the writer's opinion, they will soon have outlived their usefulness as dormitories and will be easily demolished. To consider retaining them on a permanent basis and to make a sizable investment in new graduate residential buildings nearby would be non-economic, would contribute to the isolation of the graduate student body, and would put academic plant expansion into a very small box with no flexibility.

C. The problem of married student housing

Several rundown areas between Tech and Harvard Square might be excellent locations for such development...Sydney St., Magazine St., Western Ave., for instance...but the opportunities

---

*(These figures have been only rough estimates and no doubt other combinations are possible, but the conclusions would be the same, i.e. that the redevelopment possibilities within the main plant and the acquisition possibilities East of Ames St. can not provide sufficient space without using the Alumni Houses.)

for acquiring sufficient land at reasonable cost are very slight at the moment. Families with children prevent any emphasis on land-saving, high-rise structures, and the writer believes a minimum of 16 acres would be needed for a development serving only 400 families. First of all, there is the time-consuming problem of assembling a site from a multitude of small parcels. Second, and most important, is the matter of cost.

Without government assistance, the Institute can not expect to acquire any of this land at a price reasonably comparable with its valuation. Let us assume that the average assessed valuation of the residential area between Harvard and MIT is \$1.50-\$2.50/ft^2 (land and building)*. Once the word was out that MIT wanted to buy a good deal of territory, owners would probably demand at least \$5-\$7/ft^2 and probably more--(unless small purchases were made over many years....and time is of the essence). Sixteen acres, before site preparation, would cost between \$3,500,000 and \$4,900,000. Since married student housing would bring a low return, if any at all, a development under these conditions would be completely impossible.

If an Urban Renewal program went into operation,--where the government would do the acquisition under eminent domain and would relocate families, clear the site, and turn the land over to a new user at its fair market value--such a

---

*Based on information supplied by the Planning Board and a student report by John Culp and William Barbour.

development would be possible. Also under Urban Renewal, private enterprise might consider building middle-income or cooperative apartments to serve faculty members at both MIT and Harvard.

In a recent article the writer held out high hopes for a speedy beginning to Cambridge's Urban Renewal program. The ways of politics are often devious, however, and defy all pundits' predictions. Cambridge's city planner and most of the planning board have resigned in protest against the City Council's inactivity, and--despite a new board and appointment of a part-time renewal coordinator--the Council is still in a slough. It is to the credit of the MIT and Harvard administrations that they have begun to develop contacts on their own with neighborhood leaders. These contacts might well lead to a better understanding between the universities and the citizens and to a close cooperation which would expedite renewal activity.

But it will take time, and a lot of time before the cooperation can develop and before a program is started. Professor Adams anticipates five years or more before any tangible construction results.

Married student housing can not wait five year, however. The most optimistic estimate gives Westgate and Westgate West another two or three before disintegration. MIT should not slacken its efforts towards Renewal, but married student housing has to be built within the next two or three years, which means some kind of development on land the Institute

now owns, which means land in the Westgate-West Campus area; and Plan 1 does not allow for married student housing on campus.

Plan 2 This seems a more preferable scheme than Plan 1, but it too presents difficult problems.

Under Plan 2 the academic plant would have room to grow and still remain centralized. The parking problem would be eased by one-or-two level garages below high-rise buildings, and the high-rise solution (as with Plan 1) seems the most feasible. With sufficient lounge and recreation space inside the plant and careful landscaping outside, this centralized complex need not be as cold and impersonal as it has been in the past. Use of the swimming pool and squash courts will not be decreased by removal of the Alumni Houses, and Walker can be satisfactorily converted into a much-needed meeting and dining place for faculty and personnel.

Dimunition of athletic field space is the major problem. The writer feels, however, that there may be a question of reduced efficiency in the athletic plant or of no MIT student "community" built around housing facilities. If a choice should have to be made, the first alternative seems more desirable.

Athletics at the Institute are important...but not "professional", and the opportunity for every person to participate in some sport at all times is more essential than making provision for every possible sport.

Even with a new graduate center on West Campus (which could easily be of the space-saving high-rise variety), new undergraduate dorms, and a married student development for about 400 families,* outdoor athletic fields might still possess about 500,000 ft^2 of usable space. The track, rink, football field, and some intramural fields would remain, and the baseball field could be shifted beyond the dorms. Chances are, however, that the space might be better reapportioned to provide more tennis courts and practice fields, with the games and major extramural outdoor sports except track moved to a new site. Intramural athletics would dominate the West Campus outdoor space, and, if it should prove necessary to curtail some outdoor activity, the new gymnasium would make up for it in expanded room for indoor sports.

West Campus could then become the real seat of an MIT community. Each living group would have its own distinctive type of facility--graduate students in high-rise, hotel-type structures, undergrads in low-rise, smaller buildings perhaps arranged in a cluster or along the riverbank in front of the graduate center, and married students in even lower, row-type houses on the western end, with one or two high structures for couples without children.

*Since the potential housing demand would be even greater than this, renewal activity would still be important, but could take place after 1960. If 600 families were concentrated on West Campus, field space would probably be eliminated.

West Campus would no longer be barren, desert-like and formless, with Baker and Burton looking from behind as though they were the last to survive an air raid. Most important, the physical proximity of each student group to one another and to the academic plant would reduce isolation (while the type of development for each would provide privacy commensurate with need) and would be an excellent chance to realize MIT's ideal of "community". West Campus would then have an intensity of use comparable to that on the east of Mass. Ave., but of a completely different characteer.

Admittedly, decentralization of major outdoor sports to another site would be inconvenient and might impair the effectiveness of the program. Finding a suitable site would prove difficult, but one possible location might be the large tract between Western Ave., and the Harvard Business School on the Boston side of the Charles, which is now being used by the MDC as a base for water-tunnel operations.

Other institutions like Yale and Columbia have operated such a decentralized athletic plan successfully, and transportation from West Campus could be provided.

Naturally, Plan 2 has disadvantages, but it would be easier to effectuate and more in line with MIT's objectives than Plan 1.

Plan 3 seems to be the most satisfactory long-range scheme. It has most of Plan 2's merits, but allows the athletic fields to remain where they are and expand Westward.

It will be very difficult to effectuate, however, and its success would depend on the success of an Urban Renewal program.

The major difference between Plans 2 and 3 is in the location of married student housing. Sometime within the next 2-3 years a high-rise apartment for about 200 couples and three-person families would go on the far end of West Campus. About 75-100 of the best barracks units could be saved from demolition, refurbished for students with larger families, and grouped around the high-rise unit, again as a temporary measure.

In the meantime, MIT would exert a major effort to effectuate the Renewal program. When the program went into operatiin and additional land was acquired, new, family-type married student housing might be constructed between MIT and Harvard Square, and the final temporary buildings would be demolished. The high-rise apartment could become a permanent on-campus facility for student couples, who, without the responsibilities of large families, could profit more by proximity to the Institute.

All other proposals in Plan 2...i.e. West Campus grad center, East Campus academic expansion...would remain the same in this alternative program.

During the acquisition period, some hardship would undoubtedly fall on families with children who could not find room in the limited number of on-campus accommodations. To assist them, MIT might:

a. attempt to find them suitable outside accommodations.

b. direct more loan fund resources to helping married students pay for off-campus housing.

The difficulties here would be ones of design-orientation and coordination. The high-rise building should be so oriented that it does not stick out like a sore thumb when the temporary barracks are removed. Yet it should not be placed too close to the undergraduate dorms to block their further expansion. If possible, athletic fields should extend behind and beyond it onto the present Westgate West site. Coordination difficulties would come in establishing MIT's role in the Renewal program, which would now take on greater immediate significance.

The cost of refurbishing some temporary houses would be justified by the cost saved from relocating athletic fields. However, this is no guarantee that the fields would not have to be removed eventually even if the enrollment stayed the same as projected for 1970. If fraternity housing became a real possibility, West Campus would be a logical location. There might also be a desire to erect more dormitories or bring faculty housing closer to the students, and once again field facilities would become too small. For this reason, it is strongly urged that the Institute immediately begin to examine possible locations for future field facilities.

Specific Recommendations

The following specific recommendations for future development are based on Plan 3. Several have been previously

proposed by Institute officials or committees and are asterisked for identification.

between now and 1960

1. That East Campus be used as a temporary graduate center until about 1960.
2. That two undergraduate dormitories be build on West Campus.*
3. That space be immediately obtained in 100 Memorial Drive for from 30-40 women students.*
4. That a 200-unit apartment be built for married students on West Campus, with parking space, that from 75-100 temporary barracks units be rehabilitated for longer service and the remaining barracks be razed.
5. That a student activities center be built on the suggested West Campus site*, but with a ground or basement level parking facility.
6. That the Armory be acquired, and that it be used either as a gymnasium or be demolished to make way for a well-equipped gym on the site.*
7. That combination academic building-garage facilities be built on the sites of Buildings 20* and 32.
8. That Buildings 7 and 33 be joined.*
9. That administrative activities be centralized* in Buildings 5, 7, and the new structure (8 above) and that department space be reapportioned.
10. That 100,000 ft^2 of land be acquired on Ames St.*

11. That the former truck terminal site on Vassar St. be turned into a parking lot* and that any future Vassar St. acquisitions become fringe parking facilities.
12. That a graduated rate system of parking charges be developed depending on the type of facility used (as at the University of Minnesota) or on the financial status of the person.
13. That the athletic field space be extended into the former barracks area* but that the Institute examine possible future field sites.

between 1960 and 1970

14. That Smith House and Howard Johnson's be demolished for future building sites or field space*.
15. That construction begin on a permanent graduate center on West Campus for from 700-1,000 men, with parking space (possibly underground) and room for expansion. Suggested location: on the playing fields behind Baker House.
16. That the Alumni Houses be demolished and the land used for a combination academic-garage facility.
17. That the Ames St. land be cleared and used, after street-widening, for academic and research facilities with ground level garage space.
18. That two additional undergraduate dorms be built on West Campus near Burton House.
19. That a woman's dormitory be erected on West Campus near the graduate center. Dining facilities could

be provided within the dormitory or within the graduate center.

20. That the Faculty Houses next to the President's House be remodeled to serve as living quarters for faculty members or be demolished to give way to a privately financed apartment unit.

21. That--assuming an Urban Renewal program is in operation--the Institute construct additional married student housing in a residential area of Cambridge, possibly in conjunction with Harvard.*

22. That the Institute attempt to encourage the growth of privately-financed apartments or cooperatives for faculty members in a similar location.*

23. That Walker Memorial be converted into a Faculty Club* and a restaurant-meeting facility for Institute personnel.

24. That a 3-story parking facility with space for 250-300 cars be built on the parcel which the Institute owns to the east of Building 20.

Additional considerations: Parking demands can be almost unlimited, as noted on p151. Fringe lots and ground-basement level garages in new buildings are essential, but still might not meet the demand. By parking fees and other restrictive policies, the Institute might have to curtail the expected volume of automobiles; and campaigning for better MTA service and encouraging the city to develop municipal parking facilities could prove helpful.

Whether or not the Hennessey block remains, the Institute

should encourage more restaurants and shops to locate in the area, and possibly provide them with land.

There is some discussion about demolishing Bexley Hall. While the building is not aesthetically pleasing, it should be retained until sufficient faculty and married student residences are available in the vicinity.

- - - -

Concluding Note

Within the next 15 years, MIT might expect a sizable increase in both students and personnel, an increase which will bring new demands on an already-crowded physical plant. In line with the development of educational and research objectives, this growth, plus the pressure of existing needs, might require new construction totaling from 1 500,000 to 2,400 000 ft^2 of floor space. As an overall program for dealing with these space needs, it is suggested that all future academic plant construction be located east of Mass. Ave. and south of Vassar St.; that all future student residential and recreational construction be located on West Campus, except for some married student housing; and that the Institute work with community groups and city government towards an effective Urban Renewal program which would improve the Cambridge environment and expedite construction of both faculty and married student apartments.

Although relocation is not considered advisable, classified or otherwise independent projects should locate outside of Cambridge; and there is also a strong possibility that athletic fields might have to be moved at a future date.

No design solution or cost estimates have been proposed, but a very rough guess on the latter would be about $40-60 000,000. Admittedly this is a huge sum but the demands are also huge. Other institutions, too, are facing the possibility of extensive development programs: The University of Pittsburgh, for instance, recently announced a 10-year expansion scheme that would cost $100,000,000, and in late April of this year, President Pusey asked for $40 000,000 to finance minimum improvements at Harvard. Forty to sixty millions for MIT does not seem to be out of line.

> "We seek always to provide exceptional facilities for study and research. This means more than well-equipped laboratories and classrooms, which are vital; it includes an environment which places learning in a setting of beauty, dignity, and benignity, and which as a result gives a lift to the spirit. An institute of technology has a greater need for this kind of environment, even than a liberal arts college." (1953 Pres. Rept. p 15)

The writer is well aware of the limitations of this work. Deeper research would be required at almost every stage, if an actual development program were contemplated. It is hoped, however, that the types of data presented provide an idea of what must be considered in preparing such a program and that the conclusions reached indicate the magnitude of the problems involved. In closing, the writer wishes to make one further suggestion.

MIT is at such a crisis stage in its development, that future programming should not be delegated to a series of isolated committees concerned with single aspects of growth.

Decentralization of policy-making is extremely valuable, since it allows a large number of people to air their views, but a central development committee should channel and coordinate these individual reports. This committee would carefully examine the objectives of MIT; its physical, financial, and personnel resources; and its different expansion needs. Similar in function to the Committee on The Educational Survey but broader in scope, a development group would emerge with a long-range master plan which could then be turned over to a fund-raising body as a guide for future action.

The problems are large enough, and the time is ripe enough for such an approach.

end

BIBLIOGRAPHY

1. American Society for Engineering Education: "Report on Evaluation of Engineering Education"; Urbana, 1955

2. Athletic Review Committee: "Report"; 1954, mimeographed, M.I.T.

3. Bennet, Wells: "Campus Parking"; "Traffic Quarterly"; Jan. 1956

4. Benton, William: "The Cold War of the Classrooms"; "New York Times Magazine"; April 15, 1956

5. Bowditch, Francis: "Ideas for Baker House Booklet"; M.I.T., mimeographed, 1955

6. Carpenter Committee on Student Activities: "Report"; M.I.T., mimeographed, 1951

7. Committee on The Educational Survey: "Report"; M.I.T., 1949

8. Committee on Enrollment: "Report"; M.I.T., mimeographed, 1955

9. Compton, Karl T: A Scientist Speaks; M.I.T. Undergraduate Assn., Cambridge, 1955

10. Compton, Karl T.: "Progress Towards Our Goal"; M.I.T.,1938

11. Farnsworth, Dana L.: "Maturity Through Student Counselling"; "Technology Review"; Cambridge, Jan.+ Feb., 1955

12. Harvard University City Planning students: "Term Project": Alonso, William: "Harvard Students: Their Metropolitan Distribution and Their Housing in Cambridge"; mimeographed, Harvard, 1955

13. Jester Committee to Review Athletics: "Report"; M.I.T., mimeographed 1955

14. Killian, James R.: "A Bold Strategy to Beat Shortage"; "Life"; May 7, 1956

15. Lynch, Kevin: "New England Medical Center in the South Cove"; Boston, 1955

16. Oxtoby T., Mugge R., and Wolfle P.: "Enrollment and Graduation Trends from Grade School to PhD"; "School and Society"; Oct. 11, 1952

BIBLIOGRAPHY (continued)

17. President and Deans of M.I.T.: "Annual Report"; M.I.T. 1914-55

18. Prescott, Samuel C.: When M.I.T. Was Boston Tech: Technology Press, Cambridge, 1954

19. Rivkin, Malcolm D.: "The Blight of Academe"; "The Harvard Alumni Bulletin", March 3, 1956

20. Rivkin, Steven R. and others: "Science Derives the Balanced Equation"; "The Harvard Crimson"; March 2, 1956

21. Ryer Committee on Student Housing: "Report"; M.I.T., mimeographed, 1956

22. Shillaber, Caroline E.: "Architecture of M.I.T. Buildings"; "Technology Review"; April+May, 1954

23. Stocker, A., Stevens, W., and Jackson, G.: "An Investigation of the Problems Involved in Relocating the M.I.T. Fraternities on West Campus"; Undergraduate Thesis, Course XV, M.I.T., 1955

24. Stratton, Julius L.: "Trends in M.I.T. Education: "Technology Review"; Oct. 1954

25. Student Environment Committee: "Reports"; M.I.T., Fall, 1955

26. Wolfle, Dael: America's Resources of Specialized Talent; Harper & Bros., New York, 1954

27. Women's Alumnae Assn. of M.I.T.: "The M.I.T. Coed, Then and Now"; "Technology Review"; Dec. 1955

- - - -

INDEX OF TABLES AND ILLUSTRATIONS

APPENDIX

APPENDIX

Table A1

ENROLLMENT AT M.I.T.--1865-1955

Year	Undergraduates	Percent	Graduates	Percent	Total
1865	72	100.0	-----	0.0	72
1870	224	100.0	-----	0.0	224
1875	255	100.0	-----	0.0	255
1880	253	100.0	-----	0.0	253
1885	609	100.0	-----	0.0	609
1890	936	99.9	1	0.1	937
1895	1183	99.7	4	0.3	1187
1900	1265	99.1	12	0.9	1277
1905	1440	98.3	26	1.7	1466
1910	1470	97.4	39	2.6	1509
1915	1834	96.7	66	3.3	1900
1920	3260	94.9	176	5.1	3436
1921	3297	94.1	208	5.9	3505
1922	2866	90.1	314	9.9	3180
1923	2669	91.5	280	9.5	2949
1924	2652	90.3	286	9.7	2938
1925	2465	87.7	348	12.3	2813
1926	2309	86.4	362	13.6	2671
1927	2338	86.2	374	13.8	2712
1928	2456	85.6	412	14.4	2868
1929	2621	85.5	445	14.5	3066
1930	2670	83.2	539	16.8	3209
1931	2610	81.8	578	18.2	3188
1932	2308	81.5	523	18.5	2831
1933	2106	80.9	500	19.1	2606
1934	2009	80.1	498	19.9	2507
1935	2018	79.4	522	20.6	2540
1936	2174	77.9	619	22.1	2793
1937	2305	77.7	661	22.3	2966
1938	2401	77.7	692	22.3	3093
1939	2379	76.7	721	23.3	3100
1940	2379	75.8	759	24.2	3138
1941	2376	77.8	679	22.2	3055
1942	2452	80.5	596	19.5	3048
1943	1222	77.4	357	22.6	1579
1944	849	70.9	349	29.1	1198
1945	1160	75.4	378	24.6	1538
1946	3811	73.7	1361	26.3	5172
1947	4138	73.1	1524	26.9	5662
1948	3831	70.5	1602	29.5	5433
1949	3856	70.6	1602	29.4	5458

--more--

Table A1 cont.

Year	Undergraduates	Percent	Graduates	Percent	Total
1950	3496	67.6	1675	32.4	5171
1951	3154	64.7	1720	35.3	4874
1952	3153	62.1	1921	37.9	5074
1953	3227	62.3	1956	37.7	5183
1954	3481	65.1	1867	34.9	5348
1955	3657	64.7	1991	35.3	5648

Source: Figures compiled from Registrar's Office records.

Graph A1

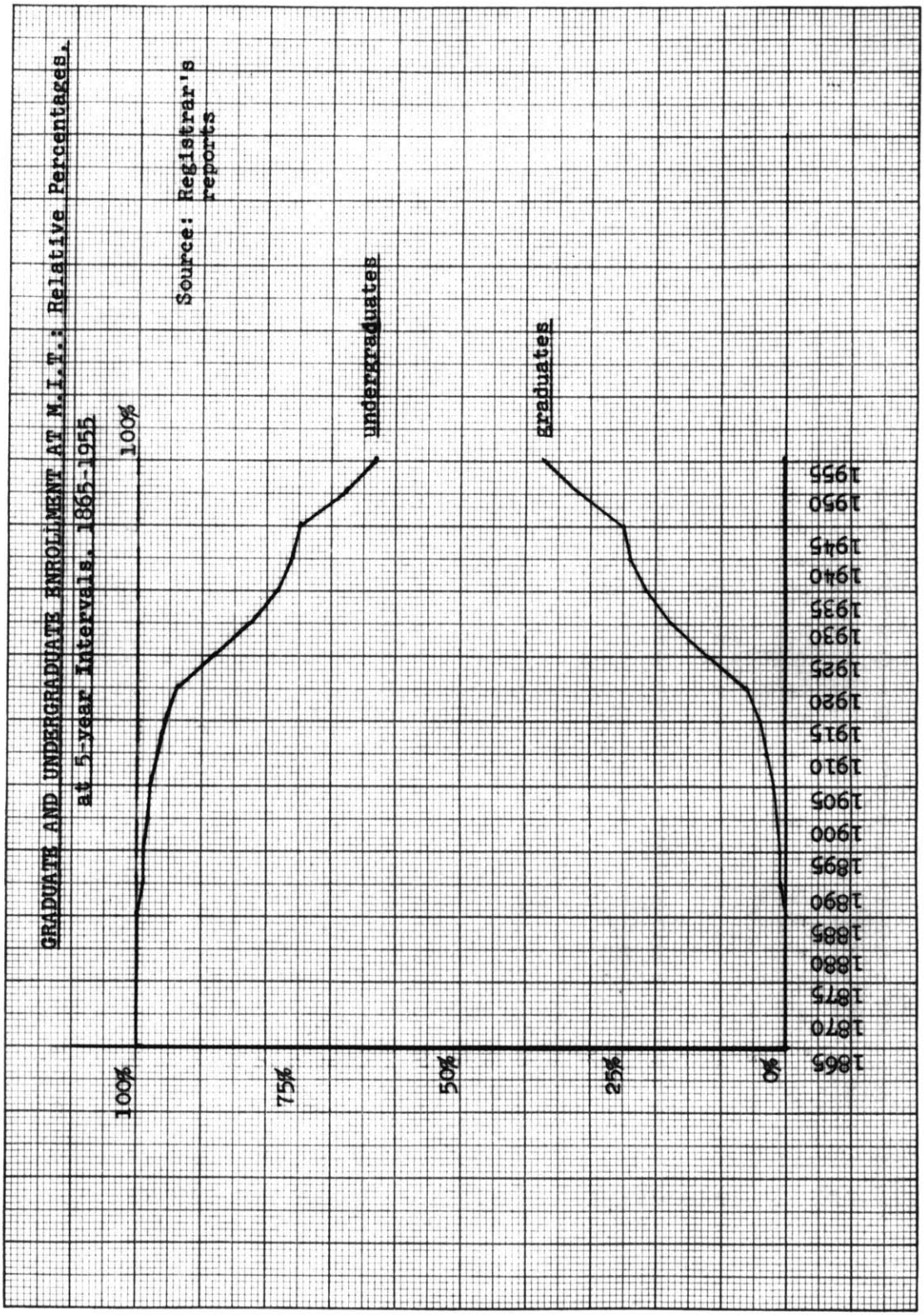

GRADUATE AND UNDERGRADUATE ENROLLMENT AT M.I.T.: Relative Percentages.
at 5-year Intervals, 1865-1955
Source: Registrar's reports
100%
undergraduates
graduates
100%
75%
50%
25%
0%
1865
1870
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955

Table A2

FACULTY AT M.I.T. AND THE RATIO OF STUDENTS/FACULTY MEMBER AS COMPARED WITH HARVARD, 1910-54

Year	M.I.T. Faculty	Undergrads/ Fac. Memb.	All Students/ Fac. Member	Undergrad Ratio at Harvard*
1910	91	16.2	16.6	
1915	117	15.6	16.2	
1920	139	23.4	24.7	
1921	170	19.4	20.6	
1922	174	16.5	18.3	
1923	175	15.2	16.9	
1924	174	15.2	16.2	
1925	179	13.8	14.9	
1926	185	12.5	14.7	
1927	199	11.7	14.4	
1928	215	11.4	14.3	
1929	220	11.9	14.6	14.4
1930	240	11.1	13.3	14.0
1931	253	10.3	12.6	12.8
1932	242	9.5	11.7	13.4
1933	235	9.0	11.1	13.9
1934	245	8.2	10.2	13.0
1935	245	8.8	10.4	13.3
1936	244	8.8	11.4	13.5
1937	267	8.6	11.1	14.0
1938	273	8.8	11.3	13.1
1939	282	9.0	11.0	13.0
1940	285	8.9	11.0	12.8
1941	292	8.1	10.5	13.3
1942	313	7.8	9.7	13.6
1943	319	3.8	4.9	5.4
1944	317	2.7	3.8	5.6
1945	330	3.5	4.7	7.7
1946	379	10.2	13.6	18.5
1947	398	10.4	14.2	18.0
1958	413	9.4	13.2	17.0
1949	435	8.9	12.5	14.6
1950	436	8.0	11.9	13.2
1951	457	6.9	10.7	12.6
1952	480	6.6	10.6	12.1
1953	503	6.4	10.3	12.1
1954	515	6.8	10.4	

*Ratio of all Harvard and Radcliffe undergraduates to faculty members of the Faculty of Arts and Sciences

Sources: M.I.T. Registrar's Reports
"Notes on Harvard College, Graphic and Statistical", Harvard, 1955

Table A 3

INVENTORY OF M.I.T. BUILDINGS* @

(For summary totals see p , Chapter III)

Building	ft^2 area
academic group and research	
1	113,544
2	113,544
3	150,260
44	153,572
5	77,992
6	85,917
7	71,986
8	61,889
10	135,305
11	19,170
12	52,513
14	148,773
16	108,835
17	6,538
20	193,940
24	80,821
28	2,994
31	64,352
32	19,909
33	41,396
35	67,507
41	25,226
43	9,652
44	3,304
46	11,037
48	25,775
52	126,157
58	9,452
58a	192
58b	258
Spec, Lab.	9,900
Magnet Lab.	987
Solar House	800
Kraft	35,170
Barta	32,865
#80	32,200
Whittemore	71,500

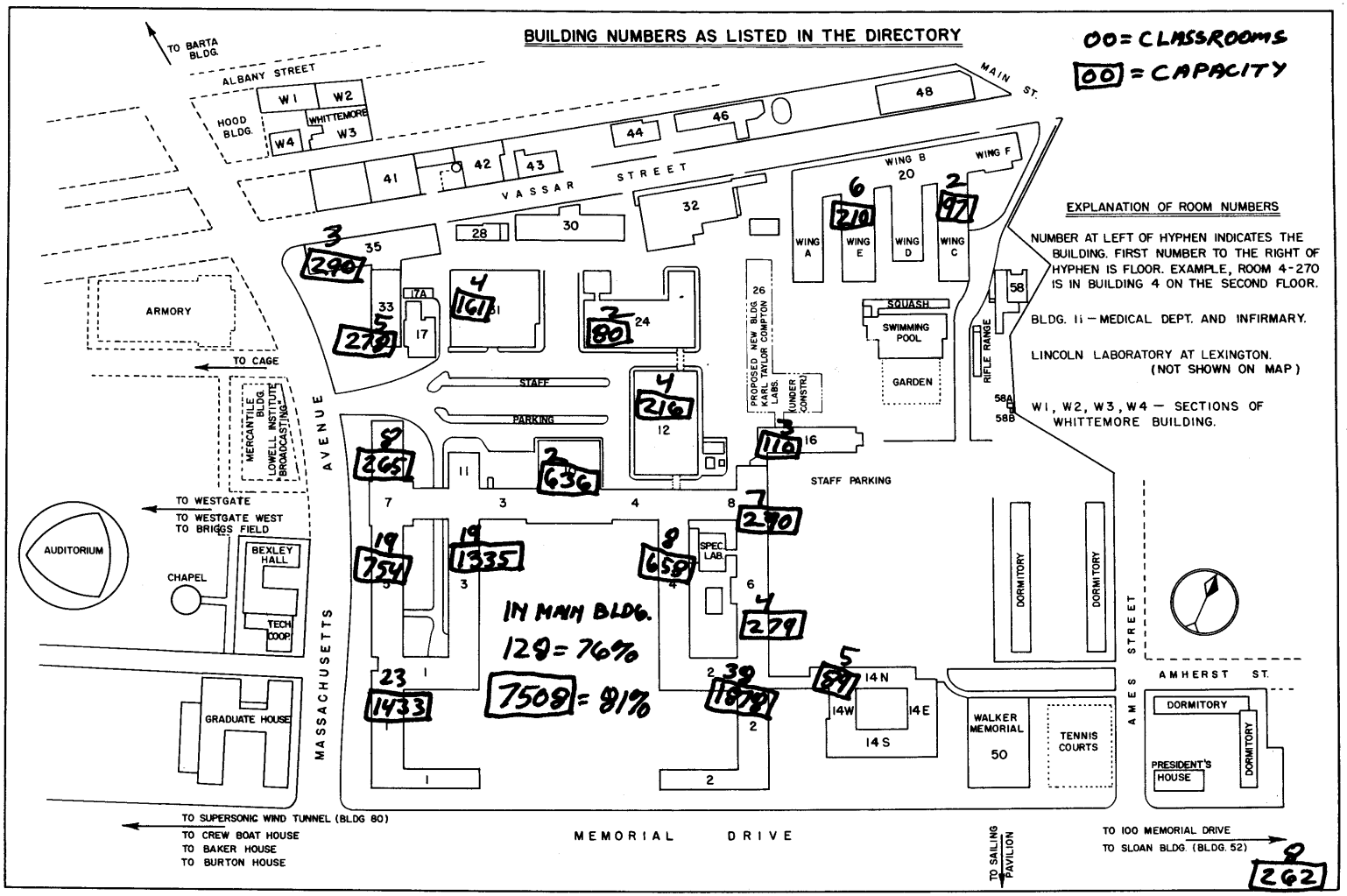
Building	ft^2 area
service and maintenance	
29	991
30	13,184
Power Plant	14,800
Pump House	734
B&P Garage	2,340
Vassar Storage	9,680
Compressor	572
Acid House	1,650
Solvent Storage	324
living units	
"Faculty" Houses	64,450
"Alumni" Houses	148,074
Baker	135,650
Burton	145,800
Grad House	173,382
Westgate	47,850
Westgate West	104,862
Bexley Hall	53,250
President's House	17,828
Dean's House	12,023
recreation	
Auditorium	43,900
Pool and Squash	30,035
Briggs	8,635
Rockwell	33,252
Pavillion	8,304
Boat House	17,625
Rifle Range	1,632
Walker	71,146
Chapel	4,160

* Source: Buildings and Power
Due to constant changes over the years, the officials do not vouch for the precise accuracy of these figures.

@ in Cambridge

Map A1

Distribution of Classrooms at M.I.T. and Their Capacities--by Buildings



Source: Registrar's Office, figures for 1955-6

Table A4

TERM RESIDENTIAL LOCATION OF M.I.T STUDENTS AND STAFF AT THE CAMBRIDGE PLANT

Community	Undergrad	%	Grad	%	Fac.-Admin.	%	DIC-DDL	%	Totals	%
Within Boston Metro. Area										
ARLINGTON	16	.48	58	3.15	54	5.06	31	5.03	159	2.33
ASHLAND	0	0	0	0	1	under .5	0	0	1	under .5
BEDFORD	3	under .5	28	1.52	13	1.22	7	1.12	51	1.70
BELMONT	17	.51	33	1.79	85	7.96	11	1.85	146	2.14
BEVERLY	1	under .5	0	0	2	under .5	0	0	3	under .5
BOSTON CITY*	1107	33.1	322	17.5	96	9.0	55	9.21	1580	23.19
Bright.-Allst.	31	.93	40	2.18	13	1.22	16	2.68	100	1.41
So. Boston	2	under .5	0	0	1	under .5	0	0	3	under .5
Dorchester	25	.75	17	.92	6	.56	10	1.67	58	.85
Roxbury	9	under .5	7	under .5	2	under .5	3	.50	21	under .5
Rosl.-Jam.Pl.	6	under .5	12	.65	5	under .5	3	.50	26	under .5
Hyde Park	2	under .5	5	under .5	0	0	0	0	7	under .5
West Rox.	13	under .5	5	under .5	5	under .5	1	under .5	24	under .5
Charlestown	1	under .5	0	0	0	0	0	0	1	under .5
BRAINTREE	3	under .5	2	under .5	1	under .5	2	under .5	8	under .5
BROOKLINE	131	3.92	59	3.16	47	4.30	14	2.35	251	3,69
BURLINGTON	0	0	0	0	2	under .5	1	under .5	3	under .5
CAMBRIDGE	1736	52.0	912	49.5	258	24.2	194	32.55	3100	45.5
CHELSEA	8	under .5	1	under .5	0	0	0	0	9	under .5
CANTON	0	0	0	0	2	under .5	4	.67	6	under .5
COHASSET	0	0	0	0	1	under .5	1	under .5	2	under .5
CONCORD	2	under .5	9	under .5	36	3.38	13	2.18	60	.88
DANVERS	1	under .5	0	0	1	under .5	0	0	2	under .5
DEDHAM	4	under .5	1	under .5	1	under .5	4	.67	10	under .5
DOVER	0	0	0	0	2	under .5	0	0	2	under .5
EVERETT	4	under .5	2	under .5	0	0	2	under .5	8	under .5
FRAMINGHAM	2	under .5	8	under .5	4	under .5	6	1.10	20	under .5
HAMILTON	0	0	0	0	0	0	0	0	0	0
HINGHAM	0	0	0	0	8	.75	3	.50	11	under .5
HULL	1	under .5	0	0	0	0	0	0	1	under .5
LEXINGTON	6	under .5	32	1.74	68	6.34	23	3.85	129	1.89
LINCOLN	2	under .5	3	under .5	21	1.97	5	.84	31	under .5
LYNN	6	under .5	2	under .5	0	0	5	.84	13	under .5
*Boston total	1196	35.8	408	22.2	128	12.0	87	14.5	1819	26.6%

Table A 4 cont.

Community	Undergrad	%	Grad	%	Fac.-Admin	%	DIC-DDL	%	Total	%
LYNNFIELD	0	0	0	0	0	0	0	0	0	0
MALDEN	6	under .5	4	under .5	2	under .5	3	.5	15	under .5
MANCHESTER	0	under	0	0	0	0	0	0	0	0
MARBLEHEAD	4	under .5	3	under .5	4	under .5	7	1.12	18	under .5
MEDFIELD	0	0	0	0	1	under .5	0	0	0	0
MEDFORD	8	under .5	9	under .5	6	under .5	3	.5	26	under .5
MELROSE	10	under .5	4	under .5	11	1.03	7	1.12	32	under .5
MIDDLETON	0	0	1	under .5	0	.75	0	0	1	under .5
MILTON	4	under .5	2	under .5	8	under .5	3	.5	17	under .5
NAHANT	2	under .5	2	under .5	0	0	1	under .5	5	under .5
NATICK	2	under .5	9	under .5	4	under .5	5	.84	20	under .5
NEEDHAM	2	under .5	10½	.54	5	under .5	8	1.34	25	under .5
NEWTON	37	1.10	41	2.18	63	5.90	29	4.86	170	2.48
NORWOOD	0	0	4	under .5	5	under .5	6	1.10	15	under .5
NORTH READING	0	0	0	0	1	under .5	2	under .5	3	under .5
READING	3	under .5	1	under .5	2	under .5	3	.5	9	under .5
PEABODY	1	under .5	1	under .5	0	0	1	under .5	3	under .5
QUINCY	16	.5	15	.82	7	.66	8	1.34	46	.67
RANDOLPH	1	under .5	0	0	0	0	0	0	1	under .5
REVERE	5	under .5	7	under .5	4	under .5	1	under .5	17	under .5
SALEM	1	under .5	1	under .5	1	under .5	0	0	3	under .5
SAUGUS	0	0	1	under .5	0	0	0	0	1	under .5
SHARON	0	0	3	under .5	3	under .5	2	under .5	8	under .5
SOMERVILLE	28	.84	21	1.14	12	1.13	6	1.10	67	.97
STONEHAM	1	under .5	1	under .5	0	0	2	under .5	4	under .5
SWAMPSCOTT	1	under .5	2	under .5	2	under .5	1	under .5	6	under .5
WAKEFIELD	3	under .5	0	0	3	under .5	1	under .5	7	under .5
WALPOLE	1	under .5	0	0	0	0	1	under .5	2	under .5
WALTHAM	3	under .5	34	1.85	11	1.03	10	1.67	58	.85
WATERTOWN	15	under .5	46	2.50	34	3.18	18	3.02	113	1.66
WAYLAND	2	under .5	1	under .5	5	under .5	0	0	8	under .5
WELLESLEY	3	under .5	4	under .5	44	4.13	4	.67	55	.81
WENHAM	0	0	0	0	1	under .5	0	0	1	0
WESTON	4	under .5	4	under .5	15	1.41	5	.84	28	under .5
WESTWOOD	1	under .5	3	under .5	1	under .5	1	under .5	6	under .5
WEYMOUTH	4	under .5	4	under .5	4	under .5	1	under .5	13	under .5
WILMINGTON	0	0	1	under .5	3	under .5	0	0	4	under .5
WINCHESTER	3	under .5	10	.54	28	2.62	7	1.20	48	.71
WINTHROP	4	under .5	5	under .5	3	under .5	2	under .5	14	under .5
WOBURN	0	0	2	under .5	0	0	6	1.10	8	under .5

Table A4 concl.

	Undergrad	%	Grad	%	Fac/-Admin	%	DIC-DDL	%	Total	%
Number within Boston Metro Area.....	3305	99.2	1814	98.5	1028	96.5	568	95.4	6715	98.5
Number in Mass. outside Boston Metro Area.....	28	0.7	24	1.2	34	3.1	29	4.6	115	1.4
Number outside Massachusetts	1	0.1	3	0.3	5	0.4	0	0	9	0.1
Total tabulated	3334		1841		1067		597		6839	

Source of data: Students----1955-6 IBM file at the Office of Statistical Services

Fac.-Admin,
DIC-DDL -1955-6 Staff Directory

Notes: Faculty and Administration personnel did not include research assistants, teaching assistants, and fellows.

DIC-DDL personnel included only those with offices in Cambridge